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MATERIA MEDICA



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TEXTBOOK OF MATERIA MEDICA

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In Memoriam

TO MY FATHER

WHOSE PATERNAL LOVE AND SYMPATHY HAVE
BEEN A CONSTANT INSPIRATION TO
THE AUTHOR
THIS BOOK IS AFFECTIONATELY DEDICATED.

PREFACE TO FOURTH REVISED EDITION

The untiring and never ending search for new and effective remedies for the cure of disease and the alleviation of human suffering necessitates frequent changes in our medical armamentarium. New drugs are constantly being discovered, and old ones become obsolete. New methods of teaching and of administration are being developed and replace old ones.

This edition is an effort to keep pace with the remarkable progress in *Materia Medica* and *Therapeutics* and in *Nursing* of the last few years. The text has been revised in accordance with the latest modifications of the standard curriculum of *Materia Medica* in training schools for nurses. It is divided into two parts: a preliminary course in *Drugs and Solutions* and a standard course in *Materia Medica* and *Therapeutics*.

The preliminary course consists of the *Introductory Chapter*, which includes *Definitions*, *Classification*, *Preparations*, etc. This is followed by *Weights and Measures*, *Solutions*, *Preparation of Doses*, *Prescription Reading* and *Administration of Medicines*. The chapters on *Antiseptics* and *Astringents* have been included in this part, since the importance of these remedies for the nurse is principally in the preparation of solutions containing them. They are therefore advantageously studied together with *Solutions*.

The rules for calculating and preparing solutions have been greatly simplified, and emphasis has been laid on the types of solutions commonly prepared, such as those from powders or crude drugs and from other stock solutions.

In the chapter on the *Preparation of Doses* stress has been laid on the preparation of doses from tablets, which are now used more extensively. Stock solutions from which to prepare doses are gradually falling into disuse in many hospitals, and this part of the text has therefore been given a secondary place.

The nurse, unlike the physician, has no choice in the use of drugs. She must administer whatever is ordered by many physicians, each of whom may have individual preferences for certain drugs. Consequently, a text book on *Materia Medica* for Nurses must contain more drugs and text than can adequately be studied in a limited course.

To permit the study of the essential drugs in a shorter course, a new departure has been made in this edition, by setting the essential text in a different type from the non-essential.

The preparations of the various drugs, the reference matter, uncommonly used drugs, and the preliminary physiology necessary for understanding the action of some of the drugs, are therefore set in smaller type than the regular text.

The method of study and arrangement of the drugs are essentially the same as in all the former editions. The inductive method of study is stressed, since it enables the nurse to learn the effects of drugs and their administration from her practical experience in the wards. Besides this, the only other methods used in studying *Materia Medica* in training schools are from the text and in the classroom. The text has therefore been simplified wherever possible, and elucidated by instructive charts, as in *Digitalis* and *Quinine*.

A new feature in this edition is a modification in the arrangement of some of the chapters in the standard *Materia Medica* course. This course begins with the chapter on Local Remedies, since these substances are easily understood. The study of Acids and Alkalies, Digestants, Carminatives, and Cathartics may then be taken up with benefit, since their effects are more or less local and easily understood.

The chapters following are then studied more advantageously, since by this time the nurse has already had considerable physiology as a groundwork, and she is better prepared by some practical experience to understand them.

An attempt has been made to keep the book up to the minute by the inclusion of all the newer remedies, such as insulin, quinine, the newer alkalies, the newer antiseptics, such as neutral acriflavine, mercurochrome, the newer hypnotics, such as luminal, allonal, new anæsthetics, immunity tests and the allergic proteins. All the obsolete drugs have been eliminated.

The chapter on Medicinal Foods has been rewritten and elaborated, to keep up with the growing importance of these substances, and especially in the use of such foods in diabetes.

I again desire to express my sincere appreciation to the many friends in both nursing and medical professions whose helpful suggestions and kindly interest in my small efforts to elucidate an important and difficult subject have been most gratifying.

Finally, especial thanks are due my publishers for their whole-hearted interest and painstaking efforts with the many technical details.

PREFACE TO FIRST EDITION

THE modern nurse is no longer merely the gentle attendant at the sick bed, able to perform only a few practical duties, but she is now also a watchful trained observer; of symptoms of disease, of the development of complications, and of the effects of drugs and their poisonous symptoms. In this capacity, and because of her constant presence at the bedside, she is of inestimable value to the physician in the management of the complex and often treacherous phenomena of disease.

The object of this text book is to develop intelligent, trained observers of the effects of drugs and to enable the nurse to administer medicines accurately. The majority of text books for nurses are entirely too technical, with the result that the nurse learns a great many technical terms without gaining a clear idea of the changes that drugs produce in the functions of the human body. An attempt is therefore made to present the subject in a strictly pedagogic manner, to teach facts, not words, and always to proceed from the known to the unknown. The new matter presented is based throughout upon facts previously explained. The pharmacological action is arranged in a simple, concise manner to facilitate the remembrance of the text. The numerous tables scattered throughout the book are intended to correlate the facts already learned; for example, a table of Cardiac Stimulants follows the discussion of the drugs in this group; a table of comparative actions follows that of the Atropine group, etc.

It is also essential that, before taking up the changes which drugs produce in the action of the body, the nurse have some idea of the normal action of the body. For this reason there have been scattered through the text numerous notes on Normal Physiology wherever it was felt to be necessary to a clear understanding of the drugs presented, since the arrangement of the curriculum in most training schools is such that Physiology is often studied at a later time than *Materia Medica*.

The nurse has ample opportunity, in the wards, to observe the effects of drugs on actual patients; but she does not benefit from this opportunity because her observation is untrained. It is to assist and train her observation that the descriptions of the

"Appearance of the Patient" are inserted in the text. These enable the nurse to compare the effects of a particular drug, given to an individual patient, with the standard description of that drug as given in the text.

Little attention is given to therapeutics; as the nurse should never treat, but administer and observe. It is occasionally important, however, that in administering certain potent drugs she should have some idea of the reason for such administration, to aid her in the observation of their effects. Short notes on the use of some of the important drugs are therefore inserted.

The chapter on "Solutions" deals with this very important subject at great length, because the proper and accurate administration of drugs, and the preparation of accurate solutions, is of prime importance to the nurse. Most of the rules for the calculation of solutions given in the text are entirely original and have been found in actual practice to be the easiest and simplest. This chapter also contains many helpful tables, such as "Saturation Points," "Usual Strengths of Standard Solutions," etc.

This book is perhaps larger than many texts on this subject but this is due to the inclusion in the text of the following features usually not dealt with: the chapter on "Solutions"; the chapter on "Prescription Reading," a subject required by most State Boards; and particularly by the inclusion, among the preparations, of most of the "New and Non-Official Remedies" in common use. Many of these substances are extensively used, and it is the nurse who has to administer them. Where is she to find the action and preparations of these drugs if not in her text book?

The classification of the drugs is based upon their therapeutic use since the nurse learns their action in this way. They are arranged in two distinct groups: "Stimulants" and "Depressants," and then according to the particular organs of the body they principally effect.

I desire to express my sincere thanks to Dr. Richard Stein and Dr. Norbert Stadtmueller for their careful examination of the proofs; and to Miss Anna L. Schulze, R. N., former Superintendent, and Miss Elizabeth P. Lindheimer, R. N., the present Superintendent of the Lenox Hill Hospital Training School for Nurses, New York, for valuable suggestions.

I avail myself of the opportunity to acknowledge the use, as references, of the following works: "Pharmacology and Therapeutics," by A. R. Cushny; "Therapeutics, Its Principles and Practice," by H. C. Wood; "Essentials of Materia Medica and Therapeutics," by Henry Morris; "New and Non-Official Reme-

dies," 1913 edition, of the American Medical Association; and to notes on the Lectures on Pharmacology delivered by Dr. W. A. Bastedo at the College of Physicians and Surgeons (Columbia University), New York.

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MATERIA MEDICA

TEXT BOOK OF MATERIA MEDICA

PART I.—PRELIMINARY COURSE PHARMACY, SOLUTIONS AND ADMINISTRATION

CHAPTER I

INTRODUCTION

Materia Medica is the study of the substances used in treating the sick. Most of these substances are drugs and the rest are serums, solutions of bacteria, or extracts of organs. The subject may be divided into three distinct branches:

Materia Medica proper, or pharmacognosy, which deals with the botanical, chemical and physical properties of drugs.

Pharmacology or pharmacodynamics, which is the study of the action, or the effects of drugs; that is, the study of the changes which drugs produce in the activities of the body, or of its organs.

Therapeutics, which deals with the treatment of disease.

For the nurse, only the first two branches of Materia Medica are of importance, as she is never called upon to treat patients, nor should she ever do so without orders from a physician. She should know, however, the properties and effects of drugs, for the physician relies upon her to see that their desirable effects are obtained, and that no unusual or poisonous symptoms occur. When these symptoms do occur, she should be able to recognize them as early as possible.

SOURCE OF DRUGS

Drugs are obtained from the mineral, vegetable, and animal kingdoms. The drugs obtained from the vegetable kingdom are made from various parts of plants, such as the roots, the bark, the flowers, the fruit or the sap; and in some instances from the entire plant.

From the crude plant, various preparations are made, so as to

be able to regulate the strength, or to measure the dose of the drug more accurately; in some instances to make the drug more palatable, or to disguise its unpleasant taste.

PHARMACEUTICAL PREPARATIONS

The preparations of drugs are made by either physical or chemical means. In the preparations made by purely physical means the drug itself is not changed. The substance is merely ground up and prepared in some special form, or dissolved in a fluid such as water, alcohol, etc. Preparations made in this way are frequently called Galenicals, because they were used extensively by Galen, a great physician who lived several centuries ago.

The chemical preparations are those made by decomposing the drug so as to obtain some of the active substances. The active principles of drugs, such as alkaloids and glucosides, are prepared in this way.

PHYSICAL PREPARATIONS

SOLID SUBSTANCES

For Internal Use

Concentrated Preparation	Common name	Latin name
	Extract	Extractum
	Powder ¹	Pulvis
	Pill	Pilula
	Capsule	Capsula
	Tablet	Tabella
	Cachet	Cachet
	Lozenge	Trochiscus
	Vescette	Vescette
	Confection	Confectio
	Sterule or ampoule ²	Sterula
	Paper	Charta

For External Use

Common name	Latin name
Ointment	Unguentum
Cerate	Ceratum
Plaster	Emplastrum
Suppository ³	Suppositorium
Lamella	Lamella

¹ Also used externally. ² May contain a liquid or solid. ³ Also used internally.

DEFINITIONS OF SOLID PREPARATIONS

Extracts are concentrated solid preparations obtained by dissolving the drug in alcohol or water, and then evaporating the solution. The resulting sediment is the extract, and is usually about four or five times as strong as the crude drug itself.

Powders are crude or other drugs ground up into a powder and used in this form.

Pills are drugs moulded in the form of a very small sphere. They should always be fresh, for when they are exposed to the air they may become so hard that they cannot be dissolved by the juices of the stomach or intestine, and will then produce no effects.

Capsules are drugs made up into a small cylindrical gelatin container which disguises the taste of the contained substance.

Tablets are dried powdered drugs which have been compressed into small discs. They are often prepared in an aseptic manner so that they can be given hypodermically. Tablets are very easily dissolved.

Cachets are small disc-like pieces of rice paper which are stuck together, enclosing between them the drug to be administered.

Lozenges are flat discs consisting of a drug made up with sugar or tragacanth or any demulcent substance.

Vescettes are effervescent salts compressed into a tablet.

Confections are preparations of drugs made up to disguise the taste of unpleasant tasting substances. They are usually made up with honey and sugar.

Sterules or ampoules are glass capsules containing a sterile solution of a drug. They are used for hypodermic administration.

Papers are small pieces of paper impregnated with medicinal substances.

SOLID PREPARATIONS FOR EXTERNAL USE

Ointments are preparations which are usually made up with lard, vaseline, oils, or other fatty substances. They are applied to the skin and are melted by the heat of the body and the drugs are then absorbed.

Cerates are preparations of drugs made up with white wax.

Plasters are preparations made up with resins, wax or lead plaster, and spread upon coarse muslin or white leather. They are applied to the skin, the mixture of the drugs which they contain is dissolved by the heat of the body, and the drugs are then absorbed.

Suppositories are cone-shaped preparations of a drug made up with cocoa butter.

Lamellæ are small gelatin discs containing medicinal substances, which are inserted between the lower eyelid and the eyeball.

FLUID PREPARATIONS

The fluid preparations may be divided into the following two groups:

(a) **Concentrated Preparations:** These are made by dissolving the drug in a fluid in which some of the extraneous matter is not soluble. The resulting fluid contains the drug in a more concentrated form and is therefore more active.

(b) **Solutions:** These are fluids in which the entire drug is dissolved.

Concentrated Preparations

<i>Common name</i>	<i>Latin name</i>
Fluidextract	Fluidextractum
Tincture	Tinctura
Infusion	Infusum
Decoction	Decoctum
Wine	Vinum
Oleoresin	Oleoresina

Solutions

In water		In alcohol	
<i>Common name</i>	<i>Latin name</i>	<i>Common name</i>	<i>Latin name</i>
Water	Aqua		
Solution	Liquor	Spirit	Spiritus
Mucilage	Mucilago		

In sugar ¹		In vinegar	
<i>Common name</i>	<i>Latin name</i>	<i>Common name</i>	<i>Latin name</i>
Syrup	Syrupus	Vinegar	Acetum
Elixir	Elixir		
		In glycerin	
		Glycerite	Glyceritum

Suspensions

(Liquids containing the drug undissolved)

<i>Common name</i>	<i>Latin name</i>
Emulsion	Emulsum
Mixture	Mistura

¹ The liquid used is water or alcohol sweetened with sugar.

Prepared by Special Methods

Oleate

Oleatum

Liniment

Linimentum

DEFINITIONS OF FLUID PREPARATIONS

Concentrated Preparations

Fluidextracts are concentrated fluid preparations of drugs made by dissolving the crude plant drug in the fluid in which it dissolves most readily. The strength and character of the fluid used therefore varies with each drug, and may be 95% alcohol, alcohol and glycerin, or dilute alcohol of various strengths. Fluidextracts, however, are always 100% in strength; that is, m. i. contains gr. i and 1.0 c.c. contains 1.0 Gm. of drug.

Tinctures are dilute alcoholic extracts of drugs varying in strength from 10 to 20%. The Pharmacopœias of all countries now agree on 10% as the standard strength for tinctures of all powerful drugs. Tinctures of weak drugs are often 20% in strength. Tincture of iodine and tincture of iron chloride, which are not extracts, are alcoholic solutions and not real tinctures. When another fluid besides alcohol is contained in the tincture this is added to the name; for example, when the alcohol contains ammonia, the tincture is called an ammoniated tincture.

Infusions are preparations of plant drugs made by pouring hot or cold water over the drug, and then allowing the mixture to steep. The strength of an infusion depends on the quantity of drug used to a definite quantity of water.

— **Decoctions** are preparations of plant drugs made by boiling the drug in water and then straining the fluid.

— **Wines** are preparations of drugs dissolved in wine. They are made like the tinctures but have a better flavor.

Oleo-resins are extracts of plant drugs made by dissolving the crude drug in acetone, ether or alcohol. They contain the resinous substance and oils of the plant.

SOLUTIONS

In Water

Waters are solutions of substances which evaporate very easily.

— **Solutions** are drugs dissolved in water. Solutions usually contain substances which do not evaporate easily.

Mucilages are gummy drugs dissolved in water.

In Alcohol

✓
Spirits are preparations of volatile substances dissolved in alcohol.

In Sugar

✓
Syrups are preparations of drugs made with sugar and water.

Elixirs are palatable preparations of drugs. They are made up with alcohol, sugar and some aromatic substance. They usually contain very small quantities of the drug.

Solutions in Other Fluids

Vinegars are medicinal substances dissolved in a weak solution of acetic acid, or vinegar.

Glycerites are preparations of drugs dissolved in glycerin.

Oleates are medicinal substances dissolved in oleic acid, which is an ingredient of many oils and fats. Oleates are more easily absorbed than ointments.

✓
Liniments are liquid or soft preparations of drugs which are applied by rubbing on the skin. The drug is usually dissolved in alcohol or in an oily substance.

Suspensions

In the following preparations the drug is contained in the fluid in fine particles:

✓
Mixtures are preparations consisting of several drugs mixed together. Fluids containing a substance which does not dissolve are also called mixtures.

✓
Emulsions are solutions of oily substances which contain the oil divided up into fine globules. They are usually of a milky color and consistency.

OFFICIAL AND UNOFFICIAL PREPARATIONS**Official Preparations**

In order that all drugs shall be uniformly prepared, and standards maintained for the strengths of the different preparations, a committee of physicians and pharmacists is appointed in every country to regulate the strengths and methods of preparation of all the drugs used in medical practice. This committee publishes a book known as the Pharmacopœia, which contains a list of the preparations of drugs whose ingredients, strengths and methods of preparation conform to a certain standard. Such preparations are called **official preparations**.

and often have the letters, U. S. P. (United States Pharmacopœia), B. P. (British Pharmacopœia), etc., written after them. Some preparations may be official in one country and not in another, though they may be used in both countries.

Unofficial Preparations

Since the Pharmacopœia committee revises the Pharmacopœia only once in ten years, many drugs and preparations are discovered in the meantime which are not listed. Many of these substances may be extensively used during that time, though they are not described in the Pharmacopœia. These drugs are called **unofficial preparations**. Some of these unofficial preparations may be subsequently accepted by the Pharmacopœia committee as conforming to its standards in strength, ingredients and action, and they then become **official preparations**. Other unofficial preparations may not be accepted by the Pharmacopœia committee at all, though they may be extensively used.

The United States Dispensatory is a private unofficial book containing a list of both official and unofficial preparations, their ingredients, preparations, and their methods of preparation. The National Formulary contains a list of the unofficial substances and their methods of preparation.

To keep pace with the new drugs that are constantly being discovered, The American Medical Association publishes annually a book of "New and Non Official Remedies" which contains a list of the new drugs that have proved to be valuable and efficient. These remedies are often distinguished by the letters N. N. R. placed after them.

ACTIVE PRINCIPLES

It was formerly thought that certain plants cured disease because of magic or supernatural powers which they possessed; and unless certain formalities were complied with in obtaining these drugs, they were not supposed to have any curative effect.

For example, in obtaining the drug hyoscyamus (henbane) it was necessary that the drug be dug up with certain precautions, and addressed as follows:

"Sacred herb, I summon thee to the house (of my patient) to stop the Rheum of his feet, etc. I conjure thee by the great name Jaoth Sabaoth." This drug contains certain active principles

(the alkaloids, atropine, hyoscyamine, hyoscyne) which are responsible for its effects.

In gathering other drugs the following formula was used: "Delve round the root and take it up with thy two hands turned upward; sing over it nine paternosters, and in the ninth, at the words 'Deliver us from evil,' snap it up," etc. Frequently it was necessary to mention the name of the sick man and his father, etc., etc.

We now know, however, that all drugs cause changes in the activity of the body by virtue of certain chemical substances which they contain.

These substances which are contained in the crude plant are called **active principles**. When they are extracted from the plant they produce the same but more reliable effects as the crude drug itself. Nearly all the active principles belong to the following groups of chemical substances:

1. Plant or Organic Acids
2. Alkaloids
3. Glucosides
4. Saponins
5. Oils
6. Tannins
7. Resins
8. Oleoresins
9. Balsams

Plant acids: Many of the fruits contain organic acids (acids containing carbon); thus, lemons contain citric acid; grapes, tartaric acid.

Alkaloids: An alkaloid is an active principle, found in plant drugs or made chemically, which acts like an alkali. (An alkali is a chemical substance which combines with acids to form salts. It turns red litmus paper blue.) Alkaloids also combine with acids to form salts, which have the same effects as the alkaloids themselves. For example, when sodium, an alkali, is added to sulphuric acid, a salt, **sodium sulphate**, is formed. When morphine, an alkaloid, is added to sulphuric acid, a salt, **morphine sulphate**, is formed.

Chemically, alkaloids consist largely of carbon, hydrogen and nitrogen.

The alkaloids do not dissolve readily in water, but their salts are very soluble and are the preparations principally used.

The alkaloids and their salts form a precipitate when tannic acid or potassium permanganate is added to them, but this precipitate is not soluble and is therefore not absorbed, thus making the alkaloids inactive. For this reason tannic acid and potassium permanganate are used as antidotes in cases of poisoning by any of the alkaloids. The names of all the alkaloids end in "ine."

Glucosides are active principles of plant drugs which always form a sugar (usually glucose, or grape sugar; hence the name), when decomposed by acids, heat, bacteria or other agents. They are neutral substances, because chemically they are neither acids nor alkalies. The names of all glucosides usually end in "in."

Saponins: These are glucosides which have some of the properties of soap; that is, they foam when mixed with water. They are found in a number of plants, such as sarsaparilla, quillaja bark, etc. They are not absorbed, but merely act locally by injuring the tissues with which they come in contact (irritating). When given internally they cause nausea, vomiting and diarrhoea. Many drugs produce these effects because of the saponins which they contain.

Oils: These are substances which have a characteristic greasy feel and with whose physical characteristics the reader is no doubt familiar. Chemically, they consist of a mixture of three substances: olein, stearin and palmitin, the three elementary fats. Each of these substances consists in turn of a fatty acid (complex organic acid) combined with glycerin. Oils are of two kinds: **fixed and volatile.**

Fixed oils comprise most of the oils in common use, such as olive, cottonseed and castor oil. The fixed oils do not evaporate easily. They are decomposed in the intestine by the digestive juices into a fatty acid and glycerin. The rancidity of fats and oils is due to a similar decomposition by heat.

The oils are utilized as foods, and medicinally they are very soothing substances. Many oils, however, such as castor oil and croton oil, when decomposed in the intestines, form fatty acids which act as drugs.

Volatile or essential oils are oils which evaporate very readily. They usually have a very pleasant aroma which gives the pleasant odor to the plants from which they are obtained. The most common volatile oils are oil of wintergreen, oil of peppermint, oil of camphor, etc. When a volatile oil is allowed to stand for some time, some of its constituents evaporate, leaving a thick film which is called a **stearoptene**.

Tannins: These are substances whose chemical composition has not yet been determined, but they seem to be acids. They are found in the bark of many trees, in witch hazel and other plants. They form insoluble precipitates with alkaloids and proteins, and are therefore used principally as astringents.

Resins: These are thick, sticky substances which form the sap of many trees. Most of these substances can be dissolved in alcohol but not in water. Some resins are solid; for example, the rosin used by violinists.

Oleoresins: These are substances found in many plants which consist of a resin combined with a volatile oil. They are usually prepared by dissolving the crude drug in acetone, ether or alcohol.

Balsams: These are resins or oleoresins which contain benzoic or cinnamic acid.

Enzymes or Ferments: These are the active principles of many animal and vegetable substances which are capable of producing very definite effects. The chemical composition of these substances is unknown, but they are destroyed by moist heat at a temperature of about 60° C. The best known enzymes are *pepsin*, the active principle of gastric juice; *trypsin*, one of the active ferments of pancreatic juice; *sinialbin*, the active ferment of white mustard, and *sinigrin*, the ferment of black mustard. Myrosin and emulsin are ferments which are found in the seeds of various plants. Since enzymes are destroyed by heat, preparations which depend upon ferments for their effects should not be given in hot liquids.

Hormones: These are the active principles of various glands in the body, such as the thyroid, the pituitary, or the adrenal. These glands secrete active elements into the blood stream, which then influence the growth, development and metabolism of the individual. Only very few of these specific hormones have as yet been isolated. Adrenalin is one of the hormones of the adrenal gland. Pituitrin is one of the hormones of the pituitary gland. Insulin is a hormone obtained from the pancreas.

TYPES OF DRUG ACTION

Any drug may cause either **local** or **general effects**.

Local effects result from the direct application of a drug to a tissue or organ. The drug combines with the albumins of their cells, forming an albuminate. If this albuminate does not readily dissolve in the surrounding fluids it protects the cells from further action of the drug. Such an effect is called an **astringent**

action. If the albuminate is readily dissolved in the surrounding fluid, more of the drug combines with the cells until they may be completely destroyed. Such an effect is called **irritation** if it is mild and **corrosion** if it is strong. Substances like caustic soda produce such effects.

General or systemic effects are the effects that result from the action of a drug upon an organ or tissue remote from the site of application. To produce a general effect a drug must circulate in the blood stream.

The process whereby a drug enters the blood stream is called **absorption**. The process whereby a drug is eliminated from the body is called **excretion**. A drug may be injected directly into the blood or find its way into the blood from the subcutaneous tissues or from the stomach or intestines. When the drug enters the blood stream the effects upon the cells will result from one of the following actions:

Physical action, Chemical action and Salt action

Physical Action: This is an action of a drug that results when some of the constituents of a cell are temporarily dissolved in a fluid drug which is brought to the cell by the blood stream. When the drug is eliminated from the body the cell constituents become normal again and the effects pass off. For example, the effect of ether on the brain is believed to be due to the fact that the ether dissolves out some of the constituents of many of the brain cells, thus modifying their function and producing unconsciousness and insensibility to pain.

Chemical Action: This is the way in which most drugs probably produce their effects. The drug or some of its constituents forms a chemical combination with some of the constituents of the cells of one or of a number of organs. We do not yet know the nature of this chemical combination, but we do know in the case of most drugs where these changes occur.

Salt Action: Salts, sugars, acids and alkalies act in a distinctive manner. This type of action is manifested especially by salts and is therefore called "salt action."

When salts or any of these substances enter the stomach or intestine they withdraw fluid from the blood and tissues thus diluting them. This process is called **osmosis**, and occurs whenever two salt solutions of a different concentration are separated by an animal membrane.

When the salt has been thoroughly diluted by the fluid withdrawn from the tissues, part of it is absorbed. Some salts, however, are very slowly absorbed and others not at all. The

absorbed salt now circulates in the blood stream until it reaches the various cells of the body in the lymph with which these cells are constantly bathed. If this lymph now contains a **greater** percentage of salt than the cell, water is withdrawn from the cell. On the other hand, if the percentage of salt in the surrounding lymph is **less** than that in the cells, the cells absorb water from the lymph. This process is called **diffusion**; it differs from osmosis since it occurs without the intervention of an animal membrane. The activity of the cells of some organs such as those of the kidney may thus be made more active by a number of salts.

Selective Action: No drug affects all the organs or tissues of the body. The ability of a drug to affect chiefly certain organs or tissues is called **selective action**. Thus, strychnine usually acts chiefly upon the cells of the spinal cord, morphine upon the cells of the brain, etc.

Synergistic Action: This is the ability of one drug to aid the effect of another.

Antagonistic Action: This is the ability of one drug to antagonize the effect of another.

Therapeutic Action: This is the effect a drug produces in diseased conditions.

Physiological Action: This is the effect a drug has on a normal animal.

Side Actions are the effects that result from a drug other than those desired.

Empiric Action: This is the effect that results from the use of a medicine in disease but which has not been corroborated by laboratory experiments.

Poisonous or Toxicological Action: This is the effect that results from an overdose of a drug.

IDIOSYNCRASY OR UNTOWARD EFFECT

Some individuals get unusual, opposite, even poisonous effects from ordinary doses of certain drugs. Occasionally, even large doses of certain drugs produce no appreciable effects. Such effects are called **idiosyncrasies** or **untoward effects**. They occur in two forms:

(a) **Idiosyncrasy of Effect:** This is a condition when small or ordinary doses of a drug cause no effects or unusual, opposite or poisonous effects. For example, morphine is a drug which usually produces sleep and quiets the patient. In some individuals it causes excitement and wakefulness.

(b) **Idiosyncrasy of Dose:** This is a condition where large doses

of a drug cause no effects, or where small doses produce excessive effects.

CUMULATIVE ACTION

Some drugs are excreted much more slowly than they are absorbed. If such drugs are administered for any length of time, a part of each dose always remains in the body. After prolonged administration so much of the drug may accumulate in the body that poisonous effects may occur. The poisonous effects which result when a drug accumulates in the body because the elimination is slower than the absorption are called **cumulative effects**.

Drugs which are apt to cause cumulative effects when given continuously, should be administered with periods of intermission during which the drug is stopped, or the dose should be gradually reduced. For example, digitalis, which may cause cumulative effects, should be given in diminishing doses or with periods of intermission when it is discontinued entirely.

CLASSIFICATION

All drugs affect the body, or an organ of the body, by either **increasing** or **lessening** its activity.

A drug which increases the activity of the body, or any of its organs, is called a **stimulant**; the act of increasing the activity is called **stimulation**.

A substance which lessens the activity of the body, or any of its organs, is called a **depressant**; the act of lessening the activity is called **depression**.

When the activity of an organ is increased to such an extent that it is overacting, it is said to be **overstimulated**.

A substance which injures the cells of a tissue or organ is called an **irritant**; the effect of such a substance is called **irritation**.

The effects produced by overstimulation may be those of lessened activity or **depression**; since, by overacting, an organ may become exhausted. For example, the poisonous effects of some drugs, which ordinarily increase the activity of the body, may be those of lessened activity.

A poisonous substance is injurious to the body because it causes overactivity of one or several organs of the body (irritation), or by greatly lessening the activity (depression).

Most drugs **increase** or **lessen** the activity only of **one** or a **number** of organs of the body.

We can classify all drugs, therefore, according to the effect

produced on the activity of the body, or on any of its organs (stimulation or depression), and according to the organs they principally affect, or for which they have a selective action.

CLASSIFICATION OF DRUGS

(Only the most important drugs are here given)

STIMULANTS

Increasing activity

DEPRESSANTS

Lessening activity

Drugs Acting on Gastro Intestinal Tract

The Stomach

To replace active substances

Acids

Dilute Hydrochloric acid

Digestants

Pepsin

Pancreatin

To neutralize acid

Alkalies

Sodium

Calcium

Magnesium

Bismuth

} Salts

Bitters and Carminatives

Gentian

Serpentaria

Cinchona

Calumba

Berberis

Cardamom

Ginger

Peppermint

Cinnamon

Emetics

Apomorphine

Ipecac

Intestinal Tract

Cathartics

Mineral Oil

Cascara

Agar Agar

Phenolphthalein

Senna

Aloes

Castor Oil

Licorice

Rhubarb

Podophyllum

Magnesium Sulphate

Magnesium Citrate

Sodium Sulphate

Colocynth

Jalap

Croton Oil

Gamboge

Elaterine

and similar substances

Anthelmintics

Drugs which Destroy Worms

For Tape Worm

Aspidium

Cusso

Pepo

Kamala

Granatum

Pelletierine

STIMULANTS

DEPRESSANTS

For Round Worm

Santonin
 Spigelia
 Chenopodium

For Thread Worm

Quassia
 (Alum)

For Hook Worm

Thymol
 Naphthol
 (Calomel)
 Chenopodium

Drugs which Affect the Blood and Blood Forming Organs

Iron
 Arsenic

Drugs which Affect the Heart

Digitalis
 Strophantus
 Squills
 (Caffeine)
 Quinidine
 Strychnine
 Atropine (Belladonna Group)
 Camphor
 Ammonia

Aconite
 Veratrum Viride

Drugs which Affect the Blood Vessels

Epinephrine
 Pituitrin
 (Ergotoxine)

Amyl Nitrite
 Nitroglycerine
 (Nitrite Group)

Drugs which Affect the Respiration

(Atropine)
 (Caffeine)
 (Strychnine)

(Opium and Morphine)
 (Chloroform)
 (Chloral)
 (Aconite)
 (Dilute Hydrocyanic Acid)

Expectorants

Ammonium Chloride
 Ipecac
 Solution of Ammonia and Anise etc.

Wild Cherry (Prunus Virginiana)
 Licorice
 Terpin Hydrate

NOTE: Parentheses around the name of a substance mean that the effect under which it is grouped is not its principal effect.

STIMULANTS

DEPRESSANTS

Drugs which Affect the Nervous System

The Brain

Caffeine
(Atropine)

Bromides
Alcohol

To Relieve Pain

Analgesics

Opium and Morphine
Cannabis Indica
Acetanilid
Antipyrine
Phenacetine
Amidopyrine
and similar coal tar products

} Act also as
Antipyretics

To Produce Anæsthesia

Chloroform
Ether
Ethyl Chloride
Nitrous Oxide

To Produce Sleep
Hypnotics

Chloral Group
Veronal
Medinal
Luminal
Trional
Sulfonal
Paraldehyde
and other similar substances

Spinal Cord

Strychnine

Drugs Acting on the Nerve Endings

Sensory Nerves

Local Anæsthetics

Cocaine, Procaine and derivatives
Menthol
Anæsthesin
Orthoform

Efferent Nerves

Drugs Acting on the Secretory Glands

Pilocarpine
(Eserine)
(Ipecac)

(Atropine)

Drugs Acting on the Involuntary Muscles

Eserine or Physostigmine

Atropine
Gelsemium
Calcium salts

STIMULANTS

DEPRESSANTS

Drugs Acting on the Kidneys

Diuretics

Caffeine
 Theobromine
 Diuretin
 Agurin
 Potassium Acetate
 Potassium Citrate
 Potassium Bitartrate
 Potassium Nitrate
 Sodium Acetate
 (Digitalis Group)
 The Nitrites
 Mercury salts, such as Calomel

Drugs Acting on the Female Genital Organs

Ergot	Viburnum
Hydrastis (Hydrastinine)	(Atropine)
Pituitrin	Coal-tar Substances
(Quinine)	

Medicinal Foods

Protein Substances	Vitamines
Carbohydrate Substances	Mineral Substances
Fats	Calcium
Fermented Milks	Phosphorus
Diabetic Foods	

Specifics

Drugs which Cure Specific Diseases

For Malaria

Quinine
 (Arsenic)

For Syphilis

Mercury
 Salvarsan or Arsphenamine
 Iodides

For Rheumatism

Sodium Salicylate
 Salicylic Acid
 Salicin
 Salol
 Aspirin
 and their derivatives

For Gout

Atophan
 Colchicum

For Amœbic Dysentery

Emetine

Organic Substances

Drugs Obtained from Various Organs of Animals

Insulin
 Thyroid Extract
 (Pituitary Extract)
 (Epinephrine)
 Adrenal Extract
 Parathyroid Extract
 Corpus luteum
 Ovarian Extract

Serums, Antitoxins, and Vaccines

Antistreptococcus Serum	Typhoid Vaccine
Antipneumococcus Serum	Staphylococcus Vaccine
Diphtheria Antitoxin	Streptococcus Vaccine
Tetanus Antitoxin	Smallpox Vaccine
Tuberculin	Toxin Antitoxin Mixtures

Allergens

Pollen Allergens	Dunbar's Serum
Food Allergens	and similar substances
Animal Hair Allergens	

Local Remedies

Drugs which Act on the Skin and Mucous Membranes

Astringents

(Drugs which Contract Tissues and Check Secretions of Mucous Membranes)

Metals

Lead	} Salts
Copper	
Zinc	
Aluminium	
Silver	
Bismuth	
Barium	

Vegetable Substances

Tannic Acid
 Gallic Acid
 Tannigen
 Tannalbin and similar substances

Antiseptics

Drugs which Check the Growth of Bacteria

Carbolic Acid	Iodoform
Creolin	Eucalyptus
Lysol	Ichthyol
Formalin	Creosote
Bichloride of Mercury	Urotropin
Iodine	Naphthol
Potassium Permanganate	Thymol
Dakin's Solution	and numerous other similar substances
Acriflavine	
Mercurochrome	
Hydrogen Peroxide	
Boric Acid	

Counterirritants*Rubefacients**Drugs which Cause Redness of the Skin*

Mustard

Turpentine

Capsicum

and other similar substances

*Vesicants**Drugs which Produce Blisters*

Cantharides

(Mustard)

Pustulants

Croton Oil

Tartar Emetic

*Caustics**Drugs which are Used to Destroy Tissues*

Mineral Acids

Glacial Acetic Acid

Caustic Potash

Caustic Soda

and strong solutions of the metallic astringents

*Demulcents and Emollients**Drugs which Soften and Protect the Skin or Mucous Membranes*

Mineral Oil

Cocoa Butter

Olive Oil

Lanolin

Glycerin

Starch

Flaxseed

Acacia

and other mucilaginous substances

Miscellaneous Substances*Flavoring Substances*

Peppermint

Spearment

Saccharin, etc.

CLASSIFICATION OF EFFECTS

Special names are given to drugs causing certain effects. The following is a list of definitions of the names given to groups of drugs according to their most important effects:

Absorbents are substances which increase the absorption of diseased tissue.

Alteratives are drugs whose mode of action is unknown, but

which improve the nutrition of the tissues and help to absorb diseased tissues, thereby restoring them to their normal condition. They are not very effective remedies and are gradually falling into disuse.

→ **Anæsthetics** are drugs which produce insensibility to pain.

→ **Local Anæsthetics** are drugs which produce insensibility to pain at the site of application.

→ **General Anæsthetics** are drugs which produce insensibility to pain all over the body. These drugs also produce unconsciousness.

→ **Analeptics** are substances which bring about health and strength.

→ **Analgesics** are drugs which relieve pain when given by mouth.

Anodynes are drugs which relieve pain when applied locally. They are usually milder in action than the analgesics.

Antacids are drugs which neutralize acids. They are usually given to neutralize the acid in the stomach.

Antiemetics are drugs which check vomiting.

Anthelmintics are drugs which destroy or expel worms.

Antiarthritics are drugs which relieve gout.

Antilithics are drugs which prevent the formation of stones.

Antiperiodics are drugs which relieve regular attacks of chills and fever, as in malaria.

Antipyretics are drugs which reduce fever.

Antiseptics are substances which check the growth of bacteria.

Antisialagogues are drugs which check the flow of saliva.

Antispasmodics are drugs which lessen contractions of muscles, and also lessen convulsions. The term is also applied to drugs which lessen nervousness, because of the tremors of the muscles which often occurs in nervous people.

Antizymotics are drugs which check the action of germs.

Aperients are substances which produce mild movements of the bowels.

→ **Aromatics** are spicy substances which increase the secretion of the stomach and intestines.

→ **Astringents** are drugs which contract or harden tissues.

→ **Bitters** are drugs which increase the appetite because of their bitter taste. They also increase the flow of gastric juice.

→ **Cardiac Stimulants** are drugs which increase the activity of the heart, so that it beats stronger and faster.

→ **Cardiac Depressants** are drugs which lessen the heart action, so that the heart beats slower and weaker.

Carminatives are drugs which produce a feeling of comfort in the stomach and relieve the formation or cause the expulsion of gas in the stomach and intestines.

Cathartics are drugs which cause movements of the bowels.

Caustics are substances which burn or destroy tissues.

Cholagogues are drugs which cause movements of the bowels, the stools being colored with bile. They are said to increase the flow of bile.

Cerebral Stimulants are drugs which increase brain activity, making the patient more active, brighter and more talkative (in large doses such drugs may produce delirium, hallucinations, convulsions, etc.).

Cerebral Depressants are drugs which lessen brain activity. The patient is dull and less active. In large doses they may produce sleep.

Convulsants are drugs which produce convulsions.

Correctives are substances used to make unpleasant drugs more pleasant to the taste.

Counterirritants are drugs which act on the skin. They cause redness of the skin, thus relieving inflammation in remote organs or tissues. By acting on the nerve endings in the skin they also relieve pain in remote organs.

Delirifacients are drugs which increase the activity of the brain, and which often cause delirium.

Demulcents are bland soothing liquids, used to coat, protect and lubricate a mucous membrane or surface of the body.

Deodorants are remedies which destroy unpleasant odors.

Depilatories are substances used to remove hair.

Depresso-motors are drugs which diminish muscular movements by lessening, the impulses for motion sent from the brain or spinal cord.

Depurants are drugs which increase the excretions of the body and thereby purify it.

Detergents are substances which clean wounds or the skin.

Diaphoretics are drugs which cause perspiration.

Digestives or **Digestants** are substances which aid the digestion of food.

Disinfectants are drugs which destroy pathogenic bacteria.

Diuretics are drugs which increase the flow of urine.

Ecbolics are drugs which contract the uterus and expel its contents; thereby producing abortion, or assisting labor.

Emetics are drugs which produce vomiting.

Emmenagogues are drugs which bring about or increase menstruation.

Emollients are drugs which soften and protect the skin and other tissues.

Errhines are drugs which increase the nasal secretions, and produce sneezing.

Epispastics or **Escharotics** are drugs which produce blisters and destroy the skin of the area over which they are applied.

Excito-motors are drugs which stimulate muscular activity and induce motion by acting on the motor areas of the brain.

Expectorants are drugs which increase bronchial secretions and expectoration.

Evacuants are drugs which move the bowels.

Febrifuges are drugs which reduce fever.

Galactogogues are drugs which increase the secretion of milk.

Hæmostatics are substances which check bleeding.

Hydragogues are drugs which produce frequent watery movements of the bowels.

Hypnotics are drugs which produce sleep.

Laxatives are drugs which produce mild movements of the bowels.

Myotics are drugs which contract the pupil of the eye.

Mydriatics are drugs which widen (dilate) the pupil of the eye.

Oxytocics are drugs which increase contractions of the uterus.

Prophylactics are medicines which prevent the development of a disease.

Purgatives are drugs which produce moderately active and frequent movements of the bowels.

Refrigerants are substances which relieve thirst and cool the patient, in fever.

Respiratory Stimulants are drugs which increase the depth and frequency of breathing.

Respiratory Depressants are drugs which lessen the frequency and depth of breathing.

Revulsants are drugs which draw blood from the deeper parts to the surface.

Rubefacients are drugs which redden the skin by widening (dilating) the capillaries.

Saline Purgatives are mineral salts which produce movements of the bowels.

Sedatives are drugs which lessen the activity of an organ or part of the body. They are usually drugs which lessen nervous excitability and soothe pain or lessen irritation.

Sialagogues are substances which increase the flow of saliva.

Somnifacients or **Soporifics** are drugs which produce sleep.

Specifics are drugs which cure specific diseases; usually by destroying or combining with, the causative agent.

Stomachics are drugs which increase the activity of the stomach and intestines. They increase the appetite and aid digestion.

Styptics are substances which stop bleeding.

Sudorifics are drugs which produce sweating.

Tænicides are drugs which destroy tape worms.

Tonics are drugs which brace up the patient. They improve the health and vigor of every part of the body. They make the patient feel stronger, healthier, more energetic, and increase the appetite.

Vermicides are drugs which destroy worms.

Vermifuges are drugs which expel worms.

Vesicatories or **Vesicants** are drugs which produce blisters.

Vulneraries are drugs which promote the healing of wounds.

CHAPTER II

WEIGHTS AND MEASURES

There are two systems of measuring drugs: one is the French or Metric System, the other is the English or Apothecaries' System.

The Metric System is the one which is used in all European countries; it has the following advantages: the units are divided into tenths, the units of length, volume and weight are similar, and the units of volume are equal to the units of weight.

In this country, the Apothecaries' System is still used, but it is gradually being superseded by the Metric System; and it is simply a question of time when the Apothecaries' System will be abandoned entirely.

THE METRIC SYSTEM

The fundamental unit of measurement in the Metric System is the one for length. This is the **meter**, which is about one ten-millionth part of the distance from the equator to the north pole. It is equal to about 39.37 inches and is written as 1.0 m.

Table of Length

The unit is 1.0				one meter
one tenth of the meter	"	0.1		one decimeter
" " " the decimeter	"	0.01		one centimeter
" " " the centimeter	"	0.001		one millimeter

Table of Surface

A surface one meter long and one meter wide is called a **square meter**, 1.0 sq. m., which is the unit of surface.

This is divided into one hundred **square decimeters**, each of which is again divided into one hundred **square centimeters**. Each square centimeter is further subdivided into one hundred **square millimeters**.

Table of Volume

The volume of a substance is the amount of space which it occupies.

A quantity of space one meter long, one meter wide and one meter high, is **one cubic meter**, which is the unit of volume.

This is divided into a thousand **cubic decimeters**, each of which is again divided into a thousand **cubic centimeters** and this in turn into a thousand **cubic millimeters**.

Table of Capacity

In measuring fluids, we measure the quantity of fluid contained in a given space. The space which the fluid occupies varies with its character and temperature; thus an oily substance will occupy less space than boiling water. We therefore take the space occupied by water at 4° Centigrade as the standard.

The unit of capacity is the **liter**, which is the amount of water contained in a volume of one cubic decimeter.

The liter is divided into **deciliters**, **centiliters** and **milliliters**. The deciliter is a tenth, the centiliter a hundredth, and the milliliter a thousandth part of the liter.

Since the liter occupies one cubic decimeter of space, the milliliter will occupy one thousandth part of that, and is therefore equivalent to the cubic centimeter.

The Pharmacopœia has adopted the term **mil**, the abbreviation for milliliter, instead of c. c. (cubic centimeter). For example, 50.0 c. c. are now written 50.0 mils, 0.3 c. c. as 0.3 mil, etc.

The quantities of medicinal fluids which the nurse is called upon to measure are usually less than a liter, so that the measuring apparatus used for measuring medicinal substances are graduated in **cubic centimeters** (c. c.). In practice this is the unit ordinarily used in measuring fluids.

Table of Weight

Solid substances are usually measured by weight.

The unit for measuring weight is the **Gram**; which is the weight of one cubic centimeter of water at a temperature of 4° Centigrade, written as follows:

	1.0	Gm., one Gram
one tenth of the Gram is	0.1	Gm., one decigram
one hundredth of the Gram	" 0.01	Gm., one centigram
one thousandth of the Gram	" 0.001	Gm., one milligram

Units greater than one Gram are given definite names, thus:

10.0 Gm.	= 1 dekagram
100.0 Gms.	= 1 hectogram
1000.0 Gms.	= 1 kilogram

Since 1.0 (one Gram) is the weight of 1 mil or 1 cubic centimeter of water, in expressing the quantities of fluids, which are measured by capacity, the denomination 1.0 means one mil or one cubic centimeter, 2.0, two mils or two cubic centimeters (2 c.c.), etc.

The nurse may overcome the difficulty of remembering the denominations of the metric system, if she remembers that the figures to the left of the decimal point correspond to **dollars** in our coinage system, and represent **Grams** in the metric system. The first figure to the right of the decimal point is the decigram, the second centigram, and the third milligram, etc. This corresponds to dimes, cents and mills respectively in our coinage system.

For example: \$1.53 is one dollar and fifty-three cents in our coinage system, and if we write it without the dollar sign, in the metric system for measuring weight, we call it one gram and fifty-three centigrams.

Practically, however; the only denominations used are the Gram, Gm., and the milligram, Mg. Thus, 5 decigrams are written as 0.5 Gm. (fif-tenths of a gram), 0.06 Gm. may be called 60 milligrams, etc.

APOTHECARIES' SYSTEM

Table of Weight

Solid substances are measured by weight.

The unit of measurement is the **grain**, which is equal to 0.065 Gm. (sixty-five milligrams) in the metric system. The grain is written thus: gr. i.

✓ 20 grains = 1 scruple, ℥	
✓ 3 scruples or 60 grains = 1 dram, ℥	
✓ 480 grains or 8 drams = 1 ounce, ℥	
✓ 5760 grains or 12 ounces = 1 pound, lb.	(this is measurement in grain)

Table of Volume

Fluids are measured by volume.

The unit of measurement is the **minim**, which is equal to 0.065 c.c. It is written, m. i.

✓ 60 minims	= 1 fluid dram (℥)
✓ 8 fluid drams	= 1 ounce (℥)
✓ 16 ounces	= 1 pint (○)
✓ 2 pints	= 1 quart (qt.)
✓ 4 quarts or 8 pints	= 1 gallon (gal.)

TABLE OF EQUIVALENTS

Value of Metric Units in Apothecaries' Units

	Grain	Dram	Ounce	Pound
One milligram.....	0.01543	0.00026	.....	.....
One centigram.....	0.15432	0.0026	0.00032	.....
One decigram.....	1.54324	0.0257	0.0032	0.00027
One Gram.....	15.43236	0.257	0.03215	0.00270
One kilogram.....	15432.3564	257.206	32.1508	2.6792

APPROXIMATE EQUIVALENTS OF METRIC UNITS

Weight

- ✓ One milligram 0.001 Gm. = $\frac{1}{64}$ of a grain
 ✓ One centigram 0.01 Gm. = $\frac{1}{6}$ of a grain
 ✓ One decigram 0.1 Gm. = $1\frac{1}{2}$ grains
 ✓ One Gram 1.0 Gm. = 15 $\frac{1}{2}$ grains (15 grains)
 (in prescriptions 15 grains)
 ✓ One kilogram 1000.0 Gms. = 32 ounces or $2\frac{2}{3}$ pounds

Volume

- ✓ One cubic centimeter, 1.0 c.c. = 15 minims
 ✓ One liter, 1000.0 c.c. = 32 ounces or 2 pints (approximately one quart)

APPROXIMATE EQUIVALENTS OF APOTHECARIES' UNITS

Weight

- One grain = 0.065 Gm. (65 milligrams)
 ✓ One dram = 4.0 Gms. (4 Grams)
 ✓ One ounce = 30.0 Gms. (30 Grams)

Capacity

- One minim = 0.065 c.c.
 ✓ One dram = 4.0 c.c. (4 cubic centimeters)
 ✓ One ounce = 30.0 c.c. (30 cubic centimeters)
 ✓ One pint = 500.0 c.c. (500 cubic centimeters)
 ✓ One quart = 1000.0 c.c. (one liter)

HOUSEHOLD MEASUREMENTS

To measure the minim (m. i) or 0.065 Gm. :

The minim is not exactly equal to the drop. There are many medicine droppers in practical use, from which each drop that is expelled is approximately equal to **one minim**.

By a drop is usually meant the drop which falls from the mouth of a bottle when it is held horizontally. **Two or two and a half** of such drops, are approximately equal to **one minim**.

TABLE OF HOUSEHOLD EQUIVALENTS

✓ ℥i (one dram) or 4.0 Gms. (4 Grams) = one level teaspoonful

✓ ℥ii (two drams) or 8.0 Gms. (8 Grams) = one level dessert-spoonful

✓ ℥iv (four drams) or 16.0 Gms. (16 Grams.) half an ounce = one level tablespoonful

✓ ℥viii (eight ounces) or 240.0 c.c. (240 cubic centimeters) = one tumblerful

METHOD OF REDUCING METRIC QUANTITIES TO THEIR APOTHECARIES' EQUIVALENTS

Rule 1. Multiply the metric quantity by 15; which gives the number of grains or minims, and reduce the result to its lowest terms.

(Since 1.0 Gm. is equal to 15 grains or 15 minims)

Example: Reduce 1.03 Gms. (1 Gram and 3 centigrams) to its apothecaries' equivalent.

Since 1.0 = 15 grains

$1.03 = 15 \times 1.03 = 15.45$ grains $15\frac{45}{100} = \text{xv}\frac{1}{2}$ grs.

Example: Reduce 64.0 Gms. to its apothecaries' equivalent.

Since 1.0 = 15 grains

$64.0 = 64 \times 15 = 960$ grains

Since there are 480 grains in one ounce, in 960 grains there are $960 \div 480 = 2$ ounces, written ℥ii

Rule 2. Divide the metric quantity by 0.065 which gives the number of grains, and reduce the result to its lowest terms.

(Since 0.065 Gm. = gr. i)

Example: Reduce 9.75 Gms. to its apothecaries' equivalent.

$0.065 \overline{)9.75}$

150 grains = $\text{℥ii}\frac{1}{2}$

To reduce very small metric quantities (less than 0.065) to their apothecaries' equivalents:

Rule 3. Write the metric quantity as the numerator of a fraction, of which the denominator is always 0.065 (65 milligrams), and reduce the fraction to its lowest terms. The result is the fraction of a grain.

Example: Reduce 0.0004 Gm. (4 decimilligrams) to its apothecaries' equivalent.

Since 0.065 (65 milligrams) is equal to 1 grain,

0.0004 (4 decimilligrams) is equal to

$$\frac{0.0004}{0.065} \text{ of a grain} =$$

$$\frac{00004}{00650} = \frac{4}{650} = \frac{1}{162} \text{ grain.}$$

0.0004 (4 decimilligrams) is equal to $\frac{1}{162}$ grain.

METHODS OF REDUCING APOTHECARIES' UNITS TO THEIR METRIC EQUIVALENTS

Rule 1. Reduce the quantity to grains and divide the result by 15. The result is the number of Grams.

Since 15 grains = 1.0 Gm. (1 Gram)

Example: Reduce ℥ii (2 drams) to its equivalent metric quantity.

$$2 \text{ drams} = 2 \times 60 \text{ or } 120 \text{ grains}$$

$$120 \div 15 = 8$$

$$\text{℥ii, 2 drams therefore,} = 8 \text{ Grams}$$

Rule 2. Reduce the quantity to grains and multiply the result by 0.065 (65 milligrams).

(Since 1 grain = 0.065 Gm.)

Example: Reduce ℥iiss (1 dram and a half) to its metric equivalent.

One dram and a half = 90 grains

Since one grain = 0.065 Gm., 90 grains will equal

$$90 \times 0.065 = 5.85 \text{ Gms. (5 Grams and 85 centigrams)}$$

To reduce fractional apothecaries' quantities to their metric equivalents.

Rule 5. Multiply the fraction by 0.065 (sixty-five milligrams), and divide the denominator into the numerator. The result is the equivalent metric quantity.

Example: Reduce gr. $\frac{1}{250}$ to its metric equivalent.

Since 1 grain = 0.065 Gm.

$$\frac{1}{250} \text{ grain is equal to } \frac{1}{250} \times 0.065 = 250 \overline{)0.065} \\ 0.00026$$

$$\frac{1}{250} \text{ grain} = 0.00026 \text{ Gm. (26 centimilligrams).}$$

APPROXIMATE EQUIVALENTS OF METRIC DOSES COMMONLY ORDERED

2.0	Gms. (2 grams)	= 30 grains
1.0	Gm. (1 gram)	= 15 grains
0.6	Gm. (6 decigrams)	= 10 grains
0.3	Gm. (3 decigrams)	= 5 grains
0.2	Gm. (2 decigrams)	= 3 grains
0.1	Gm. (1 decigram)	= $1\frac{1}{2}$ grains
0.06	Gm. (6 centigrams)	= 1 grain
0.03	Gm. (3 centigrams)	= $\frac{1}{2}$ grain
0.015	Gm. (15 milligrams)	= $\frac{1}{4}$ grain
0.008	Gm. (8 milligrams)	= $\frac{1}{8}$ grain
0.004	Gm. (4 milligrams)	= $\frac{1}{16}$ grain
0.0032	Gm. (32 decimilligrams)	= $\frac{1}{20}$ grain
0.0027	Gm. (27 decimilligrams)	= $\frac{1}{25}$ grain
0.0022	Gm. (22 decimilligrams)	= $\frac{1}{30}$ grain
0.0016	Gm. (16 decimilligrams)	= $\frac{1}{40}$ grain
0.0013	Gm. (13 decimilligrams)	= $\frac{1}{50}$ grain
0.0011	Gm. (11 decimilligrams)	= $\frac{1}{60}$ grain
0.001	Gm. (1 milligram)	= $\frac{1}{64}$ grain
0.0006	Gm. (6 decimilligrams)	= $\frac{1}{100}$ grain
0.0005	Gm. (5 decimilligrams)	= $\frac{1}{200}$ grain
0.0004	Gm. (4 decimilligrams)	= $\frac{1}{250}$ grain
0.0003	Gm. (3 decimilligrams)	= $\frac{1}{300}$ grain
0.0001	Gm. (1 decimilligram)	= $\frac{1}{600}$ grain

PROBLEMS

Reduce the following quantities to their apothecaries' equivalents:

24.06 Gms. 11.0575 Gms. 0.0055 Gm. 0.0425 Gm. 0.000275 Gm.

Reduce the following quantities to their metric equivalents:

3 iii and grs. xlii, $3\text{vii}\frac{1}{4}$, 3igrs. xx, 3iii and grs. vi, gr. $\frac{1}{15}$, gr. $\frac{1}{160}$, gr. $\frac{1}{15}$.

How would you measure the following quantities with household utensils?

$3\text{ii}\frac{1}{2}$, grs. xv, $\text{Oiii}\frac{1}{2}$, 6.0 Gms. 650.0 c.c., 15.0 c.c.

CHAPTER III.

SOLUTIONS

A solution is a liquid containing particles of a solid, gas or another liquid, so finely divided, that this dissolved substance cannot be seen, and the resulting fluid seems to be of one color and consistency.

In this chapter we shall deal only with the methods of calculation and the technique of preparation of solutions. We shall leave the discussion of the chemical properties of solutions, or the way in which substances behave when dissolved, to the chapter on the administration of medicines, where many of these properties have a definite bearing. In order to understand the subject of solutions the nurse should have a clear conception of some of the following fundamental facts:

SOLUTE AND SOLVENT

1. The dissolved substance is called the **solute**.
2. The fluid in which a substance is dissolved is called the **solvent**.

Theoretically, it is possible to dissolve any substance in any fluid. Practically, however, some substances dissolve so little in some fluids that we speak of them as being insoluble in these fluids.

The solvent may be any fluid: water, alcohol, ether, etc. The solution is frequently called by the name of the solvent, such as an alcoholic solution, ethereal solution, etc. In pharmacy definite names are given to substances dissolved in certain fluids, such as tincture, fluidextract, etc. (See preparations, page 5).

THE STRENGTH OF THE SOLUTION

The strength of the solution is the amount of dissolved substance which a given quantity of fluid contains; or the ratio of solute to solvent. It is customary to speak of the strengths of solutions in the following ways:

1. The percentage method
2. The ratio method
3. The grains to the ounce method

Percentage Method

In this method we speak of the quantity of dissolved substance (solute), which is contained in 100 parts of fluid (solvent); the solvent is, therefore, always constant. For example, by a 5% silver nitrate solution we mean that 5.0 Gms. of silver nitrate are dissolved in 100 c.c. of water.



Solvent 96 parts

Cocaine (solute) 4 parts

Total
Quantity
100 parts

Percentage Strength

¹ Diagram showing the proportion of solute and solvent in a 4% solution of cocaine

To determine the percentage strength of a solution:

Rule: Divide the quantity of solute used by the total quantity of solution made up and multiply the result by 100.

Example: What is the percentage strength of a solution that contains 2.0 Gms. of boric acid in 50.0 c.c.?

The quantity of solute is 2.0 Gms.

The total quantity of the solution is 50.0 c.c.

Dividing 2.0 by 50.0 = 0.04

Multiplying 0.04 by 100 = 4%

Ratio Method

In this method we speak of the quantity of fluid (solvent), in which one part of the drug (solute) is dissolved. The quantity of solute is therefore always constant (one part). For example, a 1 to 500 solution means that 1 part of solute is contained in 500 parts of water, 1 Gm. in 500 c.c. or ʒi in 500 drams. A 1 to 2,000 solution means that 1 part of solute is dissolved in 2,000

¹ The reader should remember that solutions are homogenous (of one color and consistency). There is no level separating the solute from the solvent. The level of the solute in this, as in all the following figures, is purely diagrammatic; for purposes of illustration.

parts of water. A 1 to 30 solution means 1 part of substance is dissolved in 30 parts of water, etc.

To determine the ratio strength of a solution.

Since the first term of the ratio is always 1, it is only necessary to determine the second term of the ratio.



Solvent 4 parts

Silver nitrate (solute) 1 part

Total
Quantity
5 parts

Ratio Strength

Diagram showing the proportion of solute and solvent in a 1:5 silver nitrate solution

Rule: To determine the second term of the ratio strength, divide the total quantity of solution made up, by the quantity of solute used.

Example: What is the ratio strength of a solution of bichloride of mercury made by dissolving a 0.6 Gm. tablet in 300 c.c. of water?

The total quantity of solution made up is 300 c.c.

The quantity of solute is 0.6 Gm.

Dividing 300 by 0.6 we get 500, which is the second term of the ratio.

Since the first term is 1, the strength of the solution is 1:500.

Grains to the Ounce Method: This method is gradually being abandoned and consists of expressing the number of grains of drug dissolved in an ounce of fluid. Like the percentage method the amount of solvent is thus always constant.

Method of Changing Percentage Strengths to Equivalent Ratios.

For purposes of calculating solutions it is not essential to change the percentage to the ratio strength, because any percentage strength may be expressed as a ratio; thus 5% is 5:100, 2% is 2:100, etc.

A percentage strength may be changed to its equivalent ratio, however, in the following way:

Since in the ratio strength the dissolved substance (solute) is always 1, we have only to determine the quantity of fluid or solvent, in which one part of the drug is dissolved or, the second term of the ratio.

Rule: Divide 100 by the percentage strength. This gives the second term of the ratio; the first term is always 1.

We thus determine the solvent of the ratio strength, which is the second term of the ratio.

Example: Change 2% to its equivalent ratio strength.

The solute in the percentage strength is 2, $2 \overline{)100}$
50

Expressing this as the second term of the ratio we have 1:50.

Method of Changing Ratio Strengths to Equivalent Percentages.

Rule: Divide the first term of the ratio by the second, and multiply the result by 100. This gives the percentage strength.

We thus divide the dissolved drug (solute), by the fluid in which it is contained (solvent).

Example: Express a 1:5000 solution of bichloride of mercury in its equivalent percentage strength.

The quantity of solvent in this example is 5000.

This contains 1 part of drug.

Dividing 1 by 5000 we get 0.0002.

Multiplying the result by 100 we get 0.02%.

SATURATION

It is not possible to dissolve any quantity of a drug in any fluid. A solution which contains as much of a solid, gas, or another fluid as it can possibly dissolve, is called a **saturated solution**. When more of the same substance is added to such a solution it does not dissolve, but falls to the bottom as a sediment, if it is heavier than the solvent, or rises to the top if it is lighter. The largest quantity of any substance which a fluid will dissolve is called the **saturation point** of that substance. Thus the largest quantity of sodium bicarbonate which can be dissolved in 100 c.c. of water is 10.0 Gms.; its saturation point is therefore 10%.

The saturation point of all substances is not the same. Thus the saturation point of potassium chlorate is 8%; of silver nitrate 100%, etc. The saturation point also varies with the fluid in which the substance is dissolved. Thus the saturation point of quinine bisulphate in water is 11%, in alcohol it is 5%, etc.

Preparation of a Saturated Solution

A saturated solution may be prepared by finding the saturation point of the substance required, from the tables on pages 35 and

36, and preparing such a solution in the usual manner. The nurse may prepare such a solution, however, by merely adding the desired substance to the fluid until it no longer dissolves but forms a sediment. The fluid is then a saturated solution of the dissolved substance.

TABLE OF SATURATION POINTS OF COMMONLY USED SOLUTIONS FOR LOCAL USE

Name of Solution	Sat. Point in Water	Sat. Point in boiling Water	Sat. Point in Alcohol	Sat. Point in Glycerin
Alum.....	10%	67%	insoluble	freely when warm
Bichloride of Mercury.	7%	47%	26%	8%
Boric Acid.....	5%	25%	5%	25%
Carbolic Acid.....	7%	All pro- portions	All pro- portions	All pro- portions
Cocaine.....	0.16%	Decom- posed	15%	....
Cocaine Hydrochloride	100%	Decom- posed	31%	soluble
Lead Acetate.....	71%	100%	3%	soluble
Potassium Chlorate...	8%	50%	insoluble	soluble
Potassium Perman- ganate	7%	28%	Decom- posed	....
Silver Nitrate.....	100%	100%	3%	....
Sodium Borate.....	6%	100%	insoluble	100%
Sodium Bicarbonate ¹	10%	Decom- posed	insoluble	....
Sodium Carbonate....	33%	55%	insoluble	....
Sodium Chloride.....	36%	37%	slightly	10%
Tannic Acid.....	75%	Very soluble	30%	10%
Zinc Sulphate.....	100%	melts	insoluble	40%

¹ It may be noted that sodium bicarbonate is decomposed by boiling, which occurs in solutions of any strength. This should be remembered in preparing sterile sodium bicarbonate solutions for intravenous use. The solution cannot be sterilized after it is prepared. The powder itself may be sterilized by dry heat at a low temperature and dissolved in sterile water when needed.

**TABLE OF SATURATION POINTS OF COMMONLY USED
SOLUTIONS FOR INTERNAL ADMINISTRATION**

Name of Solution	Sat. Sol. in Water	Sat. Sol. in boiling Water	Sat. Sol. in Alcohol	Sat. Sol. in Glycerin
Ammonium Bromide.....	77%	100%	8%	....
Ammonium Chloride.....	38%	71%	1%	17%
Ammonium Iodide.....	100%	100%	27%	66%
Calcium Oxide..	0.1%	0.05%	insoluble	soluble
Lithium Bromide.....	100%	100%	very solu- ble	soluble
Magnesium Sulphate....	100%	100%	insoluble	....
Methyl Salicylate.....	slightly	very	very	....
Potassium Acetate.....	100%	More soluble	34%	....
Potassium Bicarbonate...	36%	50%	insoluble	....
Potassium Bitartrate...	0.6%	6%	slightly	....
Potassium Bromide.....	66%	100%	5%	22%
Potassium Citrate.....	100%	very	slightly	....
Potassium Iodide.....	100%	100%	5%	50%
Potassium and Sodium Tartarate.....	100%	100%	insoluble	....
Quinine Bisulphate.....	11%	100%	5%	75%
Quinine Hydrobromide...	12%	31%	100%	14%
Quinine Hydrochloride...	5%	100%	100%	14%
Quinine Salicylate.....	slightly	Decom- posed	7%	8%
Quinine Sulphate.....	0.1%	0.9%	8%	3%
Quinine and Urea Hydrochloride	100%	100%	41%	....
Salicylic Acid.....	0.2%	6%	33%	....
Sodium Acetate.....	100%	All pro- portions	5%	....
Sodium Benzoate.....	55%	71%	1%	....
Sodium Bicarbonate.....	10%	Decom- posed	insoluble	....
Sodium Bromide.....	91%	melts	6%	....
Sodium Citrate.....	77%	100%	insoluble	....
Sodium Iodide.....	100%	100%	50%	....
Sodium Phosphate.....	37%	Decom- posed	insoluble	....

TABLE OF SATURATION POINTS OF COMMONLY USED SOLUTIONS FOR INTERNAL ADMINISTRATION—Continued

Name of Solution	Sat. Sol. in Water	Sat. Sol. in boiling Water	Sat. Sol. in Alcohol	Sat. Sol. in Glycerin
Sodium Salicylate.....	100%	Very soluble	11%	soluble
Sodium Sulphate.....	100%	Decom- posed	insoluble	soluble
Strontium Bromide.....	100%	100%	soluble	....

Note: The saturation points given in the above tables are the maximum solubilities of chemically pure substances. The salts commonly used are impure and do not always dissolve in the maximum strengths. Many of the substances in the tables, having a saturation point of 100%, can be prepared under standard conditions, in even stronger solutions. For practical purposes, however, 100% solutions are the strongest ever used. In many instances, the extra salt which can be made to dissolve in boiling water crystallizes out when the solution is cooled.

SUPERSATURATION

When a saturated solution of any substance is heated, it is able to dissolve more of the same substance. A solution which contains the largest quantity of a substance that it can dissolve when the fluid is heated is called a **supersaturated solution**. The largest quantity of a substance which may be dissolved in a boiling fluid is therefore called its **supersaturation point**. For example, the saturation point of potassium permanganate in cold water is 7%, in boiling water it is 28%.

PREPARATION OF SOLUTIONS

The solutions which the nurse usually has to prepare are all used externally or on mucous membranes. They may be used as antiseptics in the form of wet dressings, as gargles, douches, enemas, etc. Some solutions are injected directly into the veins. The nurse may prepare such solutions, but they are given by the physician.

All the solutions which the nurse may be called upon to prepare may be divided into the following three groups:

- (a) Solutions made from powders or crude substances.
- (b) Solutions made from stock solutions.
- (c) Solutions made from tablets.

SOLUTIONS MADE FROM POWDERS OR CRUDE SUBSTANCES

The following method may be used to prepare solutions from powders, from a number of tablets, or from other crude substances in pure state.

Problem : To find the quantity of drug to be used to make up a desired quantity of a given strength of solution.

Rule 1. Multiply the desired quantity by the desired strength.

Example : How much potassium chlorate would be necessary to make up one pint of a 4% solution?

Desired quantity is one pint or 500 c.c.

Desired strength is 4%.

$$\begin{array}{r} 500 \\ .04 \\ \hline 20 \end{array}$$

20 Grams of potassium chlorate will therefore have to be added to 500 c.c., or one pint of water, to make up a 4% solution.

Example : How much boric acid would be necessary to make up one quart of a 2% solution?

Reduce all the quantities to the apothecaries' units, preferably to grains, minims or drams.

$$\text{One quart} = 15360 \text{ minims}$$

Desired quantity is 15360 minims.

Desired strength is 2%.

$$\begin{array}{r} 15360 \\ .02 \\ \hline 307.20 \text{ grains} \end{array}$$

Therefore 307 grains, which is equal to approximately 5 drams, ℥v will be required.

Example : How much sodium chloride will be required to prepare 1000 c.c. of a 1:500 solution?

Desired quantity = 1000 c.c.

Desired strength = 1:500 or $\frac{1}{500}$

Therefore $1000 \times \frac{1}{500} = 2$

2.0 Gms (2 Grams) of salt must be added to 1000 c.c. of water.

When the quantity to be made up is not stated :

The nurse is frequently required to prepare a solution from a powder or crude substance in which the quantity of solution to be made up is not stated. In such instances she may use her judgment and prepare a quantity sufficient for the particular purpose required.

Example : The physician orders an ear to be irrigated with a 3% boric acid solution which the nurse must prepare. She will know from experience that about 500 c.c. of such a solution will probably be needed. She should then use 500 c.c. as the quantity to be made up and solve the problem in the manner outlined above.

Or, suppose a 5% solution of sodium bicarbonate is ordered for a gastric lavage, when the quantity of fluid is not stated. From experience she will know that for this purpose about five or six pints will be necessary. Consequently she should prepare about 2500 or 3000 c.c. of such a solution and solve the problem in the manner outlined above.

Proportion Method

The problems in the preparation of solutions from powders or crude substances may also be solved by the proportion method as follows:

Rule A. Write the problem in the form of a proportion in which the **unknown** quantity of powder or other crude substance to be used (represented by X) has the same ratio, as the ratio of drug to water in the required strength, thus:

X (the quantity of drug to be used) : the quantity to be made up :: the amount of drug : water (in the desired strength)

By multiplying both extremes together and both means together and dividing, the value of X or the quantity to be made up is determined, since the product of the extremes is equal to the product of the means.

Example : How much potassium chlorate would be necessary to make up one pint of a 4% solution?

One pint = 500 c.c., 4% = 4:100

Let X = the amount of drug to be used, then

X : 500 :: 4 : 100

Since the product of the extremes is equal to the product of the means,



Extremes are 100, and X
Means are 4, and 500
therefore, $100 X = 4 \times 500$, or 2000
or $X = 20$ Grams

20 Grams of potassium chlorate must be added to 500 c.c. (1 pint) of water to make up a 4% solution.

In the above or similar examples, it is important to reduce all the quantities to their metric equivalents, as apothecaries' quantities cannot be multiplied by metric quantities. For example, grains cannot be multiplied by Grams or cubic centimeters.

The problems may be solved in the apothecaries' quantities if they are reduced to ounces, drams or minims.

SOLUTIONS MADE FROM STOCK SOLUTIONS

In hospital practice the nurse frequently has to prepare solutions from other stock solutions. A stock solution is a solution of a definite strength usually kept on hand. *The solutions commonly prepared are usually weaker than the stock solution.*

Stronger solutions from weak ones can only be made by adding more crude substance.

Problem: To find the quantity of a stock solution of known strength to use in making up a weaker solution of a desired strength.

Rule 2. Divide the strength of the desired solution by the strength of the stock solution and multiply by the quantity to be prepared.

The problems are best solved when the strengths are expressed as fractions. The result is the quantity of the stock solution to use.

Subtract this result from the total quantity to be prepared, which gives the quantity of water to be added to make up the required solution.

The method may be used whether the desired solution and the stock solution are expressed in the percentage or the ratio strength. In either case the strength can be readily changed to a fraction. For example, 1:3000 is the same as $\frac{1}{3000}$; 2% is the same as $\frac{2}{100}$.

* The dish represents the unknown quantity of powder to be determined.

The quantities should be expressed in the Metric system. The same method may be used when the quantity of solution to be made up is expressed in the Apothecaries' system. It should then be remembered, however, that the result will be an Apothecaries' quantity.

Technique of Preparation: Measure the quantity of stock solution determined by solving the problem, and pour it into the bottle or dish in which the solution is to be prepared. Add to this the quantity of water determined by subtracting the above result from the desired quantity of solution.

Example: How much of a 5% solution of bichloride of mercury will have to be used to make up 1000 c.c. (one quart) of a 1-2500 solution?

The strength of the desired solution is 1:2500

Expressed as a fraction it is $\frac{1}{2500}$

The stock solution is 5%; expressed as a fraction it is $\frac{5}{100}$

The number of cubic centimeters to be made up is 1000, then

$$\frac{1}{2500} \div \frac{5}{100} \times 1000 \text{ or}$$

$$\frac{1}{2500} \times \frac{100}{5} \times \frac{200}{1000} = \frac{200}{25} = 8$$

The amount of the 5% solution of bichloride of mercury to be used, is therefore, 8 c.c. Subtracting this from 1000 we get the quantity of water to be added to make up 1000 c.c. of a 1 to 2500 solution.

Example: How much of a solution of silver nitrate, containing 48 grains to the ounce, must be used to make up one pint of a 1 to 1000 solution?

A solution of silver nitrate, containing 48 grains to the ounce is the same as 48 grains to 480 minims; or $\frac{48}{480} = \frac{1}{10}$ or a 10% solution.

$$1 \text{ pint} = 500 \text{ c.c.}$$

The solution to be made up, is a 1 to 1000; written as a fraction it is $\frac{1}{1000}$

The stock solution is a 10% solution, or 1 to 10; written as a fraction it is $\frac{1}{10}$

$$\text{then } \frac{1}{1000} \div \frac{1}{10} \times 500 \text{ or}$$

$$\frac{1}{1000} \times \frac{10}{1} \times 500 = \frac{10}{2} = 5$$

The amount of the stock silver nitrate solution to use, is therefore 5.0 c.c. Subtracting this from 500, we get the quantity of water to be added.

Example: How much of a 1 to 1000 potassium permanganate solution will have to be used in making up five pints of a 1-3000 solution?

The desired solution is $\frac{1}{3000}$

The stock solution is $\frac{1}{1000}$,

5 pints = 2500 c.c. (since 1 pint = 500.0 c.c.)

then $\frac{1}{3000} \div \frac{1}{1000} \times 2500$ or

$$\frac{1}{3000} \times \frac{1000}{1} \times 2500 = \frac{2500}{3} = 833\frac{1}{3} \text{ c.c.}$$

Subtract this from 2500 c.c. (5 pints) to get the quantity of water to be added.

Pour the 833 c.c. of the stock solution into the receptacle and add the necessary quantity of water.

Diagram showing the quantity of a 1:1000 potassium permanganate to use and the quantity of water to be added to make up 5 pints of a 1:3000 solution.

1667 c.c.

833 c.c.



Quantity of water

Quantity of stock solution

Example: How much of a 5% bichloride of mercury solution must be used to prepare ℥xx of a 1:2000 solution?

The desired solution is 1:2000, expressed as a fraction it is $\frac{1}{2000}$.

The stock solution is a 5% solution, expressed as a fraction it is $\frac{5}{100}$.

The required quantity is ℥xx

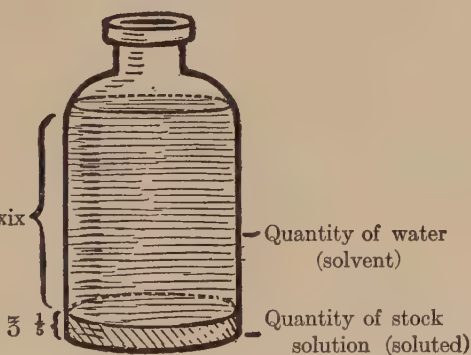
$$\text{then } \frac{1}{2000} \div \frac{5}{100} \times 20$$

$$\text{or } \frac{1}{2000} \times \frac{100}{5} \times 20 = \frac{1}{5}$$

We therefore have to use $\mathfrak{z} \frac{1}{5}$ or ℥i and m. xxxvi of the stock solution.

Subtracting this from ℥xx we get the quantity of water to be added.

Diagram showing the quantity of 5% ℥ xix of bichloride of mercury to use and quantity of water to be added, to make up ℥ $\frac{1}{5}$ of a 1:2000 solution.



When the quantity to be made up is not stated :

When the quantity of a desired solution to be made up from a stock solution is not stated, the nurse may use her judgment and prepare a quantity needed for the purpose for which the solution is to be used. She may then solve the problem in the manner outlined above, using this quantity as the quantity to be made up.

Problem: To make up a definite quantity of stock solution from stock tablets of a definite strength.

The method of Rule 2 may also be used to determine the number of tab-

lets needed to make up a definite quantity of solution from stock tablets of a definite strength. When solving the problem, however, we use the strength of the tablet expressed as a fraction, instead of the strength of the stock solution. The result will be the number of tablets to be used.

Example: How many tablets of novocaine gr. $\frac{1}{4}$ must be used to prepare 100 c.c. of a 1% solution?

The solution required is 1%.

The stock tablets are gr. $\frac{1}{4}$. The quantity to be prepared is 100 c.c. or 1500 minims.

According to the rule $\frac{1}{100} \div \frac{1}{4} \times 1500$ or

$$\frac{1}{100} \times \frac{4}{1} \times 1500 = 60.$$

Sixty gr. $\frac{1}{4}$ tablets when dissolved in 100 c.c. of water make a 1% solution

SOLUTIONS MADE FROM TABLETS

The nurse is occasionally required to prepare solutions from tablets of a definite strength, especially in household practice. These problems may be solved by either of the following methods:

Problem: To find the quantity of water in which to dissolve a tablet of known strength to make up a solution of a desired strength.

Rule 3: Divide the tablet by the strength of the desired solution. The result is the quantity of water in which it is to be dissolved.

Example: In how much water is it necessary to dissolve a gr. vii $\frac{1}{2}$ tablet to prepare a 1:4000 solution?

The strength of the tablet is gr. vii $\frac{1}{2}$, which equals 0.5 Gm. The desired solution is 1:4000. According to the rule,

$$0.5 \div \frac{1}{4000} \text{ or}$$

$$0.5 \times \frac{4000}{1} = 2000 \text{ c.c.}$$

The gr. vii $\frac{1}{2}$ tablet will therefore have to be dissolved in 2000 c.c. of water.

PROPORTION METHOD

Rule B: Write the problem in the form of a proportion in which the stock tablet has the same ratio to the unknown quantity of water (represented by X) as the ratio of drug to water in the desired strength, thus:

Strength of tablet : X :: drug : water (in desired strength), X being the amount of water to be used.

(In any proportion the outer numbers are called extremes and the inner ones means.) The product of the means of any proportion is always equal to the product of the extremes.

Multiply both means together and both extremes together. Since their

products are equal an equation is thus formed. By dividing the right side of the equation by the left with the exception of the X, we determine the value of X, or the quantity of water in which the tablet is to be dissolved.

Any problem can be solved in this manner no matter whether the strength of the desired solution is expressed in the percentage or ratio method, since in either case the required strength may readily be expressed as a ratio. The strength of the tablet, however, should always be expressed in the metric system.

Example: In how much water would you dissolve a 0.3 Gm. tablet of bichloride of mercury to prepare a 1:2000 solution?

Let X represent the unknown number of cubic centimeters of water to be used. Then the tablet has the same ratio to the unknown number of cubic centimeters of water, as 1 is to 2000; since whatever the quantity of fluid will be, the 0.3 Gm. tablet must be $\frac{1}{2000}$ part of it. Writing the problem in the form of a proportion, we have,

$$0.3 : X :: 1 : 2000$$

The extremes in this example are 2000 and 0.3.

The means in this example are X and 1.

Since the product of the means is equal to the product of the extremes,

$$X = 0.3 \times 2000 = 600$$

Therefore, we dissolve the tablet in 600 c.c. of water.

SUMMARY OF SOLUTIONS

The difficulty in solving problems in solutions may be readily overcome if the nurse will work out each problem in a systematic manner. Before solving any problem she should determine the following points:

1. Is the solution to be prepared from a powder, a salt or other crude substance? Such problems may be solved by Rule 1, page 38.

2. Is the problem one in which it is required to prepare a definite quantity of a weaker solution from a stronger stock solution? These problems should be solved according to Rule 2, page 40.

3. Is the problem one in which to determine the quantity of water in which to dissolve a given tablet? Such problems should be worked out according to Rule 3, page 44.

When the group to which the problem belongs has been determined, the problem should be solved according to the appropriate rule, preferably with pencil and paper.

Finally, it must be remembered that one can only become expert in solving solution problems by continual practice.

**TABLE OF USUAL STRENGTHS OF COMMONLY USED
SOLUTIONS FOR EXTERNAL USE**

Name of Solution	Percentage of Solution	Quantity to Quart
Acriflavine (neutral).....	1-5000 to $\frac{1}{2}\%$	$\text{℥ iii}-\text{℥ i}\frac{1}{4}$
Alcohol.....	50 to 95%	$\text{℥ xvii}-\text{xxx}$
Aluminium Acetate (Burrow's Solution) Stock sol.	2 to 7%	$\text{℥ v}-\text{℥ ii}$
Aluminium Acetate (Burrow's Solution) for local use.....	$\frac{1}{2}$ to 2%	$\text{℥ i}-\text{v}$
Argyrol.....	5 to 25%	$\text{℥ i}\frac{1}{2}-\text{viii}$
Boric Acid.....	3%	℥ i
Calcium Chloride..... (for intravenous use)	5%	$\text{℥ i}\frac{2}{3}$
Calcium Hydroxide Solution (lime water).....	$\frac{1}{5}\%$	℥ ss
Carbolic Acid.....	2 to 5%	$\text{℥ v}-\text{℥ i}\frac{1}{2}$
Collargol.....	4%	$\text{℥ i}\frac{1}{4}$
Cocaine Hydrochloride.....	$\frac{1}{2}$ to 4%	$\text{℥ i}\frac{1}{4}$
Chlorine Water.....	0.4%	
Corrosive Sublimate (Bichloride of Mercury) Stock Alcoholic Solution.....	2%	℥ v
Corrosive Sublimate (Bichloride of Mercury) (for use).....	0.01 to 0.1%	
Creolin.....	(1-1000 to 1-10000)	grs. ii-xv
Cresol.....	$\frac{1}{2}$ to 2%	$\text{℥ i}\frac{1}{4}-\text{v}$
Dakin's solution (Sodium Hypochlorite).....	5%	$\text{℥ i}\frac{1}{2}$
Eserine Sulphate.....	0.45%	$\text{℥ i}\frac{1}{8}$
Eserine Salicylate.....	$\frac{1}{2}$ to 1%	$\text{℥ i}\frac{1}{4}-\text{ii}\frac{1}{2}$
Formalin (Stock) Solution...	$\frac{1}{2}$ to 1%	$\text{℥ i}\frac{1}{4}-\text{ii}\frac{1}{2}$
Formalin (for use).....	40% of formaldehyde gas	
Glucose (for intravenous use).....	0.05 to $\frac{1}{2}\%$	gr. x- $\text{℥ i}\frac{1}{4}$
Holocain.....	3-20%	$\text{℥ i}-\text{vi}\frac{2}{3}$
Hydrogen Peroxide.....	1 to 2%	$\text{℥ ii}\frac{1}{2}-\text{v}$
	3%	℥ i

TABLE OF USUAL STRENGTHS OF COMMONLY USED SOLUTIONS FOR EXTERNAL USE

Name of Solution	Percentage of Solution	Quantity to Quart
Ichthyol.....	5 to 50%	$\mathfrak{Z}i\frac{1}{2}$ -xvi
Iron Subsulphate (Monsell's Solution).....	13%	$\mathfrak{Z}iv$
Iodoform.....	5 to 10%	$\mathfrak{Z}i\frac{1}{2}$ -iii
Labarraque's Solution (Solution of Chlorinated Soda).....	$2\frac{1}{2}\%$	$\mathfrak{Z}vi$
Lugol's Iodine Solution.....	5%	$\mathfrak{Z}i\frac{1}{2}$
Lysol.....	$\frac{1}{2}$ to 3%	$\mathfrak{Z}i$ - $\mathfrak{Z}i$
Mercurochrome.....	$\frac{1}{2}$ to 1%	$\mathfrak{Z}i\frac{2}{3}$
Naphthol.....	1 to 50%	$\mathfrak{Z}ii\frac{1}{2}$ - $\mathfrak{Z}xvi$
Pilocarpine Hydrochloride...	$\frac{1}{2}$ to 2%	$\mathfrak{Z}i\frac{1}{4}$ -v
Potassium Chlorate.....	2 to 5%	$\mathfrak{Z}v$ - $\mathfrak{Z}i\frac{1}{2}$
Potassium Permanganate....	1 to 5%	$\mathfrak{Z}ii\frac{1}{2}$ - $\mathfrak{Z}i\frac{1}{2}$
Procaine (Novocaine).....	$\frac{1}{4}$ to 4%	grs. xxxv- $\mathfrak{Z}i\frac{1}{4}$
Protargo!.....	$\frac{1}{2}$ to 10%	$\mathfrak{Z}i\frac{1}{4}$ -iii
Resorcin.....	25%	$\mathfrak{Z}viii$
Sodium Chloride (salt) (Normal Solution).....	0.9%	$\mathfrak{Z}ii$
Sodium Chloride (salt) (Physiological Solution).....	0.6%	$\mathfrak{Z}i\frac{1}{2}$
Silver Nitrate.....	1 to 20%	$\mathfrak{Z}ii\frac{1}{2}$ -vi
Zinc Chloride.....	1 to 2%	$\mathfrak{Z}ii\frac{1}{2}$ -v
Zinc Sulphate.....	$\frac{1}{4}\%$	grs. xxxv

PROBLEMS

Strengths

Express the percentage strength of the following solutions:

- 150.0 c.c. of solution containing a 0.3 Gm. tablet of bichloride of mercury.
- 500.0 c.c. of solution containing 0.6 Gm. of potassium permanganate.
- 30.0 c.c. of solution containing 0.5 Gm. of boric acid.
- One quart of solution containing $\mathfrak{Z}ii$ of alcohol.
- One pint of solution containing $\mathfrak{Z}i\frac{1}{4}$ of carbolic acid.

Express the ratio strength of the following solutions:

- 500 c.c. of solution containing 10.0 Gms. of boric acid.

2. 3000 c.c. of solution containing 0.25 Gm. of silver nitrate.
3. 5 pints of solution containing two-gr. viiss tablets of bichloride of mercury.
4. One pint of solution containing $\mathfrak{Zvi}$ and grs. xv of silver nitrate.
5. $\mathfrak{Zx}$ of solution containing $\mathfrak{Zv}$ of carbolic acid.

Express the following percentages in ratios: 4%, 0.6%, 0.9%, 8%, 20%.

Express the following ratio strengths in percentage: 1:30, 1:2500, 1:60, 1:5000, 1:75.

Solutions from Powders and Crude Substances

In each of the following problems determine the quantity of powder or crude substance to be used:

1. To prepare two quarts of a 2% boric acid solution.
2. To prepare one quart of a saturated solution of sodium bicarbonate.
3. The quantity of salt needed to prepare one quart and a half of physiological salt solution.
4. The quantity of salt needed to prepare enough normal salt solution for two intravenous infusions.
5. To prepare 1 pint of a $\frac{1}{2}\%$ creolin solution.
6. To prepare one gallon of a 2% carbolic acid solution.
7. To prepare 8 ounces of a 25% glycerin solution.
8. To prepare a saturated solution of sodium bicarbonate for an ear irrigation.
9. To prepare a 5% sodium bicarbonate solution for washing out the stomach.
10. To prepare a saturated boric acid solution for an ear irrigation.

From Stock Solutions

In each of the following problems determine the quantity of stock solution to be used:

1. To prepare 2500 c.c. of a 1:8000 solution of bichloride of mercury from a 5% solution.
2. To prepare 1000 c.c. of a 1 to 5000 solution of bichloride of mercury from a 1 to 30 solution.
3. To prepare 1 gallon of a 2% solution of creolin from a 1:4 solution.
4. To prepare 1000 c.c. of a 1:500 Burow's solution from a 2% solution.

5. To prepare one quart of a 1:10000 silver nitrate solution from a $\frac{1}{2}\%$ solution.
6. To prepare 15 ounces of a 2% carbolic acid solution from a 50% solution.
7. To prepare 500 c.c. of a $\frac{1}{2}\%$ solution of formalin from a 40% solution.
8. To prepare enough of a 1:5000 solution of mercury oxy-cyanide from a 2% solution for a bladder irrigation.
9. How many tablets of cocaine hydrochloride gr. $\frac{1}{8}$ should be used to prepare 4 ounces of a $\frac{1}{2}\%$ solution?
10. How many tablets of morphine sulphate gr. $\frac{1}{4}$ should be used to prepare 60 c.c. of a Magendie's solution? ✓

Solutions from Tablets

In each of the following problems determine the quantity of water to be used:

1. To prepare a 1:8000 solution from a 0.2 Gm. tablet of bichloride of mercury. *c.c.*
2. To prepare a 1:12000 solution from a gr. viiss tablet of corrosive sublimate. How would you measure and prepare such a solution in a home?
3. To prepare a $\frac{1}{2}\%$ solution from a 0.3 Gm. tablet of potassium permanganate.
4. To prepare a $\frac{1}{2}\%$ solution of novocaine from tablets of gr. $\frac{1}{4}$.
5. To prepare a 1 to 2500 solution of mercury oxycyanide from a 0.1 Gm. tablet.
6. To prepare a 1 to 20 solution of sodium bicarbonate from a tablet of gr. v.
7. To prepare a $\frac{1}{2}\%$ solution of mercury oxycyanide from a tablet of 0.5 Gm.
8. To prepare a 5% solution of corrosive sublimate from a tablet of 0.1 Gm.
9. To prepare a solution of bichloride of mercury containing gr. v to the $\mathfrak{Ji}$ from tablets of gr. iii.
10. To prepare a bichloride of mercury solution gr. i to the quart from tablets of 0.1 Gm.

Miscellaneous

In each of the following problems determine the rule to be applied and solve the problem accordingly:

1. In how much water should a gr. v bichloride of mercury tablet be dissolved to prepare a 0.05% solution.

2. How many tablets of cocaine hydrochloride gr. $\frac{1}{8}$ should be used to make $\mathfrak{Z}$ ii of a 1:50 solution?

3. How much sodium bicarbonate should be used to prepare a sufficient quantity of a 5% solution for five wet dressings for a wound of the hand?

4. How much of a 3% solution should be used to prepare 1500 c.c. of a 1:10000 silver nitrate solution?

5. How much phenol should be used to prepare 30 c.c. of a $\frac{1}{2}$ % solution?

ca. 5

CHAPTER IV

ANTISEPTICS

Antiseptics or disinfectants are drugs which check the growth of bacteria (bacteria are very small unicellular microscopic organisms, many of which cause disease). They are divided into two groups: **germicides** and **antiseptics**.

Germicides or **disinfectants** are drugs which destroy bacteria. **Antiseptics** are drugs which check the growth of bacteria, usually by making the fluid in which they grow unfit for them to live in. **Deodorants** are drugs, most of which are also antiseptics, that destroy unpleasant odors.

The antiseptics, while checking the growth of bacteria, are also injurious to the tissue cells. They must therefore be used in solutions so weak that the drug will only destroy the bacteria, and do little harm to the tissues. Antiseptics may be classified according to their practical use in the following way:

(a) Local Antiseptics

1. Disinfectants for rooms.
2. Disinfectants for excreta, clothing, etc.
3. Antiseptics for the hands.
4. Antiseptics for the skin.
5. Antiseptics for wounds, ulcers, sinuses, etc.
6. Antiseptics for mucous membrane lined cavities, as gargles, douches, etc.

(b) Antiseptics acting after absorption

1. Antiseptics acting on the lungs.
2. Genito-urinary antiseptics.

✓ DISINFECTANTS FOR ROOMS

✓ FORMALDEHYDE

Formaldehyde is a gas obtained by oxidizing wood alcohol. A solution containing 40% of formaldehyde gas is called **formalin**.

Formaldehyde gas vigorously destroys bacteria (germicide

action) and checks their growth (antiseptic action). It also neutralizes unpleasant odors (deodorant).

When formaldehyde gas is inhaled, it causes stinging and prickling sensations in the nose, with a profuse flow of mucus from the nose, a flow of tears from the eyes, secretion of saliva, and excessive coughing, with profuse expectoration.

Uses

Formaldehyde gas is used principally to fumigate rooms and to disinfect clothing. It is generated in the following ways:

1. By heating a solution of formalin in the room; 150 c.c. of formalin are necessary to disinfect a room of 1000 cubic feet of space.

2. By heating paraform, a solid substance which liberates formaldehyde gas. There are numerous lamps on the market which liberate formaldehyde gas in this way.

3. By a specially constructed apparatus for generating formaldehyde gas. The gas is allowed to enter the room through a rubber tube which is inserted in the keyhole.

When disinfecting with formaldehyde gas, the cracks in the door should be stuffed with cotton and the room should be kept closed for 24 hours. The unpleasant odor is removed by sprinkling ammonia water about the room.

Formalin is used in 1-200 solutions to sterilize instruments. There are a number of instrument sterilizers on the market which generate formaldehyde gas and sterilize the instruments in this way. Formalin has also been used as a mouth wash and as a douche in 1-500 to 1-1000 solutions.

It is occasionally used as a preservative for milk and other foods. A 4% solution of formalin is used to preserve tissues for microscopic examination.

Preparations

Formalin

(Liquor Formaldehydi)

This contains 37% of formaldehyde gas.

Paraform or Paraformaldehyde

(Trioxymethylene)

This is a solid substance which liberates formaldehyde gas on heating. It is used locally to destroy warts and also internally as an antiseptic.

There are a number of other preparations which liberate formaldehyde gas in the body; they will be described under their particular use.

✓SULPHUR DIOXIDE

Sulphur dioxide or sulphurous acid is a gas which is formed when sulphur is burned. It is one of the oldest disinfectants in medicine, being used

since 1771. It is an excellent disinfectant for rooms, but it is apt to injure clothing, linens, carpets, etc.

Uses.—Sulphur dioxide is formed when sulphur candles or sulphur masses are burnt in the room. The sulphur should be placed in a metal or porcelain dish placed in a basin of water, and the sulphur should then be burned. All cracks and keyholes in the room should be tightly closed.

✓ CHLORINE (CHLORUM)

Chlorine is an element which occurs in the form of a greenish yellow gas. It is obtained from sea salt, and a number of its compounds are used as disinfectants.

Chlorine, bromine, and iodine are three closely related elements called halogens, since they are all obtained from the sea; thus: chlorine from sea salt, bromine from sea water, and iodine from sea weeds.

Chlorine gas is one of the most efficient disinfectants known; especially when it is used in the presence of moisture. The chlorine combines with the hydrogen of the water, setting oxygen free. The oxygen then destroys the bacteria. A 0.3% solution of chlorine will destroy even the spores of bacteria in about three hours. It also removes obnoxious odors very readily (deodorant).

Uses

Chlorine is used principally to disinfect stools and urine. It is used in the form of chlorinated lime; which liberates chlorine gas. It has a special advantage in removing foul odors. Concentrated chlorine gas, liberated by a specially constructed generator, is used to disinfect rooms. It is very efficient; but it bleaches various dyed materials. It is prepared by placing a dish containing equal parts of black oxide of manganese and salt in the center of the room. To this is added one tablespoonful of strong sulphuric acid, diluted one third. Enough chlorine gas will thus be formed to disinfect the room.

Chlorine gas has recently been used in the treatment of influenza. It is given by inhalation in very dilute form by means of a special apparatus.

Preparations

✓ Chlorinated Lime or Bleaching Powder (Calx Chlorinata)

This is a grayish white powder containing 35% of chlorine gas when fresh. It is sometimes erroneously called chloride of lime. A fresh powder forms a clear solution; otherwise the solution becomes turbid.

✓ DISINFECTANTS FOR EXCRETA, CLOTHING, ETC.

For this purpose formalin is occasionally used in 10% solutions.

✓ CARBOLIC ACID (PHENOL)

Carbolic acid or phenol is a crystalline solid substance which readily absorbs moisture from the air. It is made by distilling coal tar; it dissolves readily in water, alcohol or glycerin.

Antiseptic Action.—Carbolic acid destroys all living tissues

(protoplasm). In weak solutions (2-5%) it checks the growth of all bacteria except their spores, which are resistant forms. It is the most efficient antiseptic known.

Local action: Concentrated solutions destroy the skin by hardening or coagulating the proteins of the cells. This forms a white crust which becomes red and shiny. The crust falls off in a few days, leaving a light-brown area. Weak solutions (2-5%) produce a feeling of warmth and tingling followed by numbness and contraction of the skin. Applied to wounds, carbolic acid causes pain and redness with the formation of a white pellicle of coagulated albumin.

Local applications of carbolic acid solutions, if prevented from evaporating, as when applied in the form of a wet dressing, often destroy the skin and deeper tissues causing gangrene. Gangrene of a finger or other part of the body has occasionally resulted from continued use of such wet dressings. For this reason its use as a wet dressing has been given up.

Uses

Carbolic acid was the first substance used as an antiseptic. It was formerly sprayed in operating rooms to disinfect the air, since most infections were supposed to come from the air. Later knowledge of the nature of infections has proven the worthlessness of this use. At the present time carbolic acid is used:

1. To disinfect sinks, toilets, sputum cups, clothing, etc., in 2-5% solutions. The articles must be soaked in carbolic acid for a half to several hours. Knives and scissors are sometimes kept in stronger solutions even full strength.

2. To disinfect the sick room by washing the walls and furniture. The fumes are often inhaled from such use and cause slight poisonous symptoms.

3. It is occasionally given internally in very small doses to check vomiting, and as an intestinal antiseptic to check fermentation in the intestines. It may cause an increased flow of a green-colored urine and excessive flow of saliva from such use.

↓ Poisonous Effects

Acute poisoning from carbolic acid is not an infrequent occurrence as a result of attempts at suicide, since it is the easiest poison to obtain.

↓ Symptoms

If a large quantity of carbolic acid is taken, the patient becomes unconscious and dies within a few minutes, from a sudden paralysis of the heart and respiration. This is probably due to the sudden destruction of a large area of mucous membrane which produces collapse.

If smaller quantities are taken, the following symptoms appear in the order of their onset: Some of these symptoms also occasionally result from the continued use of wet dressings.

1. Pain around the mouth and lips and in the stomach. The lips and mouth are blanched.
2. Nausea and vomiting.
3. Headache, dizziness, drowsiness and depression.
4. Collapse: rapid thready pulse, cold moist skin, the pulse falls to 40 or 50 per minute, the breathing becomes irregular, difficult and shallow, and because of the shallow breathing, the patient becomes cyanotic.
5. Finally, the patient goes into stupor and coma, and may die from paralysis of the respiration, in about one to ten hours.

Occasionally, convulsions occur just before death. A very characteristic symptom of carbolic-acid poisoning is the dark-green color of the urine, and the odor of the acid on the breath. The fatal dose is usually about $\mathfrak{z}$ i-iv.

✓ Treatment

- ✓ 1. Wash out the stomach with 20% alcohol.
2. The following salts are given as antidotes: about $\mathfrak{z}$ i of one of the salts dissolved in a glass of water.

Magnesium sulphate (Epsom salt).

Sodium sulphate (Glauber's salt).

Lime water and milk.

They form sulphocarbolates, harmless salts of carbolic acid.

3. Give alcohol in the form of whiskey or brandy, or even in 20% solutions. The alcohol neutralizes the carbolic acid; its mode of action is unknown. (A carbolic-acid burn is readily neutralized, if followed immediately by the application of alcohol.) The stomach should be washed out, however, as the solution is readily absorbed.

4. Protect the mucous membrane of the mouth and œsophagus with albumin water, flaxseed tea or milk. Do *not* give oils or glycerin as they help to absorb the carbolic acid.

5. The collapse is treated with heart stimulants such as caffeine, strychnine, atropine, etc., and the patient should be kept warm.

✓ Preparations

Carbolic Acid:

(Phenol)

This comes in crystals which readily take up water (hygroscopic). It is used principally for its destructive action on tissues (corrosive action).

✓ Liquid Carbolic Acid:

(Phenol Liquefactum)

This contains 90% of carbolic acid.

Glycerite of Phenol 0.12-0.3 c.c. m. ii-v

(Glyceritum Phenolis)

This contains 20% of phenol dissolved in glycerin.

Carbolic Acid Ointment

(Unguentum Phenolis)

This now contains 2% of carbolic acid, formerly 5%.

Carbolic Acid Derivatives**✓Cresols**

There are a number of oily substances which are extensively used as antiseptics, and are chemically closely related to carbolic acid.

They are oily solutions, which do not dissolve readily in water and are used as emulsions or in soapy solutions. The antiseptic, physiological and poisonous actions of all of them are like those of carbolic acid.

Preparations

✓**Cresol** 0.06 c.c. m. i

This is a mixture of all the cresols.

Compound Solution of Cresol
(**Liquor Cresolis Compositus**)

This is a 50% solution of cresol in soap solution. It is used in dilute solutions as a disinfectant.

Tricresol

This is a mixture of all the three cresols.

Kresamine
(**Ethylenediamine Tricresol**)

This contains 25% of tricresol and is used as an antiseptic like phenol and as an ointment for skin diseases.

✓**Creolin**

This is an emulsion of cresol. It is used in 1-5% solutions to disinfect sinks, excreta, toilets, etc. It is also used in $\frac{1}{2}$ to 1% solutions for vaginal douches, and for bladder irrigations. Creolin solutions must be made up with warm water.

✓**Lysol**

This is a 50% solution of cresols dissolved in soap. It forms a frothy solution in water and is used for douches and other irrigations in $\frac{1}{2}$ to 1% solutions.

Lysoform

This is a combination of lysol and formaldehyde which is used as a disinfectant in 5 to 10% solutions.

OTHER SUBSTANCES

Zinc Sulphate,
Iron Sulphate

These substances are occasionally used as antiseptics for excreta such as stools or urine. Zinc Sulphate is used with 2 parts of sodium chloride or salt. Iron Sulphate is used in an equal part of water.

Solution of Chlorinated Soda 0.6-1.3 c.c. m. x-xx
(**Liquor Sodæ Chlorinatæ**)
(**Labarracque's or Javelle's Solution**)

This is a solution made from chlorinated lime and sodium carbonate. It contains sodium hypochlorite and sodium chloride. It liberates about $2\frac{1}{2}\%$ of chlorine gas and is used for cleaning medicine droppers, douche nozzles and other small utensils. It is especially valuable to remove stains. It is occasionally given internally in half a tumbler of warm milk.

Antiformin

This is a strongly alkaline solution of sodium hypochlorite. It rapidly dissolves the bodies of all bacteria, except the tubercle bacilli. It dissolves all secretions such as sputum and also destroys unpleasant odors. It is therefore a disinfectant, antiseptic and deodorant. It is said to be a stronger disinfectant than carbolic acid. It is also used in testing the sputum and other secretions, for tubercle bacilli. Antiformin is used externally in 2-10% solutions, and as a spray in 1-1000 solutions.

ANTISEPTICS USED TO DISINFECT THE HANDS

The following antiseptics are used principally to disinfect the hands of the surgeon or nurse when performing or assisting at an operation, or when dressing wounds. To obtain the maximum antiseptic action, the hands should be kept in the solution for about five to fifteen minutes.

Bichloride of Mercury or Corrosive Sublimate (Hydrargyri Chloridum Corrosivum)

This is used as an antiseptic in 1-10,000 to 1-1000 solutions. Continued use of bichloride is apt to irritate the skin, causing redness and itching. The solution should always be fresh, as the bichloride combines with the bacteria so that old solutions become inactive. It cannot be used to disinfect instruments as it turns them black (corrodes).

Mercuric Cyanide (Hydrargyri Cyanidum)

This is used in solutions of 1-4000 to 1-2000 like bichloride of mercury, but it does not corrode instruments and does not injure the skin.

Mercury Oxycyanide (Hydrargyri Oxycyanidum)

This is used like bichloride of mercury. It has a greater antiseptic power, is less injurious to the tissues, and does not corrode instruments. It is used in 1-5000 solutions.

Sublamine (Mercuric Sulphate Ethylendiamine)

This is similar to calomel. It is used in solutions of 1-1000 to disinfect the hands, and for irrigations. It is also given in 3-4% solutions intramuscularly for syphilis.

Alcohol in hospital stock 45% - use 65%

This is used in 50-70% solutions as a very efficient antiseptic for the hands. Stronger solutions are not as active because they harden the capsules of the bacteria and do not penetrate the bacteria themselves.

"Lime and Soda"

A very common method of disinfecting the hands is by rubbing chlorinated lime and sodium carbonate together in the hands. Chlorine gas is liberated in this way, which disinfects the hands.

ANTISEPTICS USED TO DISINFECT THE SKIN

IODINE (IODUM)

Iodine is a non-metallic element obtained from the ashes of sea weeds. Iodine itself is not used in medicine, but various solutions and compounds of it are frequently employed. The iodides are salts of iodine which are given internally.

Antiseptic Action: Iodine checks the growth of bacteria, having a marked disinfectant action. It is used very extensively to disinfect the skin in preparation for operations. It should not be applied in a concentrated solution or when the skin is moist, as it is then apt to cause blisters or even to destroy the deeper tissues.

Local action: Iodine stains the skin a dark-brown color and makes it red and warm. Strong solutions cause blisters and may even destroy the skin. It is also slightly absorbed from the skin. **On mucous membranes:** It produces redness, smarting and increases the secretions.

Poisonous Effects

Acute poisoning from iodine occurs very rarely; usually from the injection of iodine into cysts in order to obliterate them, and occasionally from iodine taken with suicidal intent.

Symptoms

1. Nausea and continuous vomiting. The vomited matter contains iodine which turns blue if starch is also present.

→ 2. Diarrhoea.

→ 3. Cyanosis (blue color of the skin).

4. Collapse, rapid thready pulse, cold moist skin, slow shallow breathing and dilated pupils. Death may occur in a few days.

Treatment

Give boiled starch as an antidote. Protect the mucous membrane with albumin water, milk or other protecting drinks; treat the collapse with heart stimulants; such as caffeine, atropine, strychnine, etc.

"Iodism"

Continued use of iodine often causes the following symptoms, in susceptible individuals:

- 1. Skin eruptions, beginning at the site of application, consisting of areas of redness.
- 2. Increased secretion of mucus from the nose and bronchi.
- 3. Rapid pulse.
- 4. Nervousness and tremors of the fingers.

The symptoms usually disappear when the iodine applications are stopped.

Preparations

➤ Tincture of Iodine (Tinctura Iodi)	0.06-0.3 c.c.	m. i-v
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This contains 7% of iodine and 5% of potassium iodide in alcohol.

Compound Iodine Solution (Liquor Iodi Compositus) (Lugol's Solution)	0.2-0.8 c.c.	m. iii-xii
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This contains 5% of iodine dissolved in 10% of potassium iodide solution.

Iodine Ointment
(Unguentum Iodi)

This contains 4% of iodine.

Sulphur Iodide
(Sulphuris Iodidum)

This is a mixture of iodine and sulphur.

SULPHUR

Sulphur is an element which occurs in the form of a yellow powder. It is found in volcanoes and also as compounds of various metals forming sulphides (a sulphide is a compound of sulphur with another element or with a metal). The action of sulphur is due to the sulphides which it forms in the body.

Applied to the skin it slightly checks the growth of bacteria and destroys parasites (parasiticide). It is used on the skin principally in the form of an ointment. It stains silver objects black, by forming silver sulphide.

Preparations

➤ **Sulphur Ointment**
(Unguentum Sulphuris)

This contains 15% of sublimed sulphur with benzoin and lard.

Liver of Sulphur
(Potassa Sulphurata)

This is a preparation of sulphur which is often used in ointments and baths in doses of 3i-vi of sulphur to a gallon of water. This substance is very destructive to tissues (corrosive).

— ICHTHYOL

Ichthyol is a substance obtained from a peculiar bituminous mineral found in the Tyrol. It is formed as deposits of fossil fish and contains about 10% of sulphur in the form of sulphoichthyolic acid.

Ichthyol is used as an antiseptic in various skin affections, and to soften the skin.

Preparations

Ichthyol 0.2–2.0 c.c. m. iii–xxx
(**Ammonii Ichthyosulphonas**)

This is a reddish brown substance which dissolves readily in water. It is used in the form of watery solutions or ointments in from 1–20% solutions.

Ammonium Ichthyolate or Hirathiol
(**Ammonii Sulphoichthyolicum**)

Ichthargan
(**Argenti Ichthyosulphonas**)

This contains 30% of metallic silver and 15% of sulphur. It combines the action of both.

Thiol

Thiol is an artificial substance formed by the action of sulphur on the tar obtained from brown coal. It acts like ichthyol. It is used in the treatment of burns and skin diseases. It comes in the form of **dry thiol** containing 8% of sulphur or as **liquid thiol** containing 2% of sulphur.

— RESORCIN

Resorcin or resorcirol is a chemical substance made from carbolic acid, which acts as an antiseptic and disinfectant.

Uses.—It is used principally as an antiseptic in skin diseases, such as dandruff, baldness, etc. It is occasionally used as an intestinal antiseptic and to reduce temperature.

Preparations

Resorcinol 0.12–0.6 Gms. grs. ii–x
(**Metadioxybenzol**)

Externally this is used in 5–10% solutions.

Euresol
(**Resorcin Monacetate**)

This acts like resorcin and is used principally for dandruff and baldness.

PYROGALLOL

Pyrogallol or pyrogallic acid is a crystalline substance made by heating gallic acid.

Applied to the skin or mucous membranes it checks the growth of bacteria, acting as an antiseptic; it destroys parasites and produces redness of the skin. It usually stains the skin or clothing a dark brown color. It is used in skin diseases in the form of 5-20% ointments.

Pyrogallol is occasionally absorbed from the skin and produces poisonous symptoms which resemble those of carbolic acid poisoning. (See page 54.)

PINE TAR OR TAR (PIX PINI OR PIX LIQUIDA)

Tar is a black, semi-solid, sticky substance of a peculiar characteristic odor and taste. It is an oleoresin, obtained by the destructive distillation of the wood of various species of the pine tree, especially the *Pinus palustris* or the pine tree of North Carolina. (Destructive distillation is a process of decomposition by heating. Some of the decomposed products are vapors, and become fluid or semisolid when passed into a cold receptacle.)

When tar is distilled, it forms the oil of tar, an oily liquid, and a solid black residue called pitch. It consists of a number of substances; the following are the most important ones: creosote, pyroligneous acid, wood alcohol, and a number of other compounds.

Action. Tar is used principally as an antiseptic and irritant in skin diseases. It usually causes considerable inflammation. When the skin becomes severely inflamed, the fact should be reported to the physician. Tar should be applied with great care to the face and parts of the body where the skin is tender.

Internally, it is principally used as a stimulating expectorant, especially in chronic bronchitis. It is occasionally used to destroy intestinal worms, and as an intestinal antiseptic.

Tar Ointment

(Unguentum Picis Pini)

(Unguentum Picis Liquidæ)

This contains 50% of tar.

Oil of Cade

This is a substance made by destructive distillation of Juniper wood. It is used as an antiseptic and irritant in skin diseases.

ANTISEPTICS USED AS DRESSINGS FOR WOUNDS, ULCERS, SINUSES

The following antiseptics are the ones most frequently used as wet dressings or to irrigate wounds, ulcers and sinuses:

Corrosive Sublimate

In 1-10,000 to 1-1000 solutions.

(Bichloride of Mercury)

Aluminium Acetate Solution

(Burow's Solution)

This is used in $\frac{1}{2}$ to 2% solutions and is especially valuable when it is desired to harden the tissues.

"Borosal" Solution

(Thiersch Solution)

This is a solution made by dissolving a Thiersch powder in 1000 c.c. or a quart of water.

Each Thiersch powder contains:

Boric Acid	15.0-30.0 Gms.	$3\frac{1}{2}$ -i
Salicylic Acid	2.0- 4.0 Gms.	$3\frac{1}{2}$ -i

Thiersch solution is used as an antiseptic dressing, and is particularly valuable to soften the skin.

DAKIN'S SOLUTION

Dakin's solution is a specially prepared solution of sodium hypochlorite. This substance has long been used as an antiseptic in the form of Labarracque's or Javelle's solution. Dakin's solution is prepared in a very special way. It must contain exactly 0.45-0.50% of sodium hypochlorite. If the percentage is less the solution is inactive; while if it contains more, the solution is very irritating. Furthermore, the solution must be absolutely neutral in reaction when tested with phenolphthalein, otherwise the solution cannot be used.

Action: Dakin's solution is one of the best antiseptics now in use. The employment of this substance according to the method devised by Dr. Carrel has practically revolutionized the treatment of wounds in the World War and since. It is about fifteen times as strong in its antiseptic power as carbolic acid; yet it does not injure the young growing tissue cells, consequently it does not retard healing as do most other antiseptics.

Dakin's solution produces its effect by liberating free chlorine which combines with some of the constituents (the NH radical) of the proteins in the wound, thus forming new compounds called **chloramins** which are the active antiseptic substances. At the same time they increase the flow of lymph from the wound surfaces.

Carrel-Dakin Method of Treatment of Wounds

The practical method for using Dakin's solution in the treatment of wounds was originally devised by Dr. Alexis Carrel of the Rockefeller Institute.

A fresh, exactly neutral solution is allowed to flow into the wound by means of a specially constructed apparatus. This apparatus consists of a graduated bottle and a long tube which terminates in a number of fine rubber tubes with small holes in their sides. These terminal tubes, wrapped around with small pieces of gauze, are placed in the wound in such a position that the fluid runs downward but in contact with every part of the wound. Small pieces of gauze are placed between the tubes. About every two hours enough fluid is allowed to flow through the tubes to just fill the wound. This intermittent flow is essential because the solution is absorbed by the tissues and new fluid is then required.

Dakin's solution dissolves clots and dead tissue in the wound. It is therefore essential that all the blood vessels be tied before the treatment is begun; since dissolving a clot over an open blood vessel may cause a hemorrhage.

Since Dakin's solution is irritating, the skin around the wound should be covered with sterile vaseline for protection. If the patient complains of pain, it means that the solution is flowing under too great pressure or that it has not been properly prepared.

Preparations

Surgical solution of Chlorinated Soda. (Dakin's Solution.)

This is a specially prepared exactly neutral solution of sodium hypochlorite

Chloramine T (Chlorazene)

This is a sodium compound of a complex organic chlorine preparation. It is four times as strong as phenol. It acts like Dakin's solution; it is more stable, lasts longer but it has not the dissolving power of Dakin's solution. It is used in 1 or 2% solutions applied in the same manner as Dakin's solution. It is also used as a mouth wash and as an irrigation for the urethra, bladder and uterus.

Chloramine B

This is a sodium preparation of a complex organic chlorine preparation (Sodium benzenesulphochloramene). It is used in the same manner and it has the same effects as chloramine T.

Chlorcosane

This is a thick liquid consisting of liquid paraffin containing chlorine in a stable, non-active combination. This substance is used merely as a solvent for dichloramine T so as to prevent the chlorine combining with the oil (which is already combined with chlorine) which would otherwise prevent its action. It is used as a spray.

Holazone

This is a complex organic chlorine compound. It acts like Dakin's solution but it does not decompose readily. It is used in tablets of 0.004-

0.008 Gm. together with sodium borate and sodium chloride. Each tablet is dissolved in a liter of water.

Dichloramine T

This is an organic chlorine compound prepared by Dakin. It does not dissolve very readily in water. In wounds it is used in 10 or 15% solutions. It is used as a spray for the nose and throat and in wounds; usually dissolved in chlorococane, or in chlorinated paraffin or in chlorinated eucalyptol.

Hyclorite

This is a solution of chlorinated soda 4.05 Gms., sodium chloride 3.2 Gms., calcium hydroxide 0.17 Gm. It acts like Dakin's solution but it is less alkaline, and contains more chlorine. It is used in solutions of 1:1000 to 1:100 for irrigations. It is used in direct applications in 1:1 or 1:2 solutions.

OTHER NEW ANTISEPTICS

→ Acriflavine
 → Mercurochrome
 → Gentian Violet

} see page 72

Chinosol

Chinosol or oxyquinoline sulphate is an artificial chemical substance which comes in the form of a yellow powder. It is used as a powerful antiseptic for the skin, as a nasal spray, as a gargle and as a douche in 1-5000 to 1-1000 solutions.

Alumnol

(Alumini Naphtholsulphonas)

This is used in $\frac{1}{4}$ -1% solutions as a surgical antiseptic, as a gargle and for douches.

Phenoco

This is a mixture of coal tar creosote and other coal tar derivatives in soap solution. It is used as a surgical antiseptic in 1-5% solutions.

OXIDIZING DISINFECTANTS

The following drugs act as disinfectants by liberating oxygen when they come in contact with organic matter:

→ HYDROGEN PEROXIDE

Hydrogen peroxide or hydrogen dioxide is a liquid which is a chemical compound of equal parts of hydrogen and oxygen. A 3% solution of hydrogen peroxide is used in medicine.

Action: Hydrogen peroxide solution is decomposed when it comes in contact with organic matter, such as pus or blood. It then yields bubbles of oxygen. The oxygen then destroys the bacteria with which it comes in contact and disinfects the tissues.

At the same time it helps to loosen membranes and pieces of dead tissue (sloughs). The effect of the peroxide wears off very rapidly. The more pus or dead tissue present in the wound, the more oxygen is liberated.

Hydrogen peroxide is used principally to irrigate wounds or sinuses containing pus. It is also used in infections in the mouth and throat and other mucous membrane lined cavities.

It is used, together with sodium bicarbonate, to bleach the hair.

Preparations

Hydrogen Dioxide

(Aqua Hydrogeni Dioxidi)

This contains about 3% of hydrogen peroxide and forms about ten volumes of oxygen for every volume used.

Metallic Peroxides

The following drugs are compounds of hydrogen peroxide made by replacing the hydrogen by a metal. They act as disinfectants and antiseptics like hydrogen peroxide, by liberating oxygen. Their effect is said to be more lasting, however, since the oxygen is given off very slowly. They are often used internally as intestinal antiseptics.

Calcium Peroxide	0.06-0.3 Gm.	grs. i-v
(Calcii Peroxidatum)		

Magnesium Peroxide	0.25-0.5 Gm.	grs. iv-viii
(Magnesii Peroxidatum)		

Sodium Peroxide		
(Sodii Peroxidatum)		

This is only used externally in the form of a paste or soap in skin diseases like acne.

Oxone

This is a preparation of fused sodium peroxide.

Strontium Peroxide

(Strontium Peroxidatum)

Zinc Peroxide

(Zincum Peroxidatum)

These are used externally in the form of gauze, as a dusting powder or a 10% ointment. Peroxide zinc soap is a soap containing 10% of zinc peroxide.

POTASSIUM PERMANGANATE *K.M.NO₄*

Potassium permanganate is a salt of manganese.

When potassium permanganate comes in contact with organic substances, such as the albumins of the tissues, it combines with

them and liberates oxygen, which destroys bacteria, acting as an antiseptic and disinfectant. When it has combined with the albumins, it no longer liberates oxygen and is therefore not effectual. For the hands and wounds it is used in 1-3% solutions. It is also used as a gargle and for douches in 1-1000 to 1% solution.

It is used occasionally in poison ivy rash. In India it is used for snake bite.

Preparations

Potassium Permanganate (Potassii Permanganas)	0.06-0.2 Gm.	grs. i-iii
Zinc Permanganate (Zinci Permanganas)		

This acts like potassium permanganate and is principally used as an injection in gonorrhœa.

ANTISEPTIC POWDERS

The following substances are used principally as antiseptic dusting powders or ointments.

— IODOFORM

Iodoform is a yellow crystalline powder which has a very characteristic odor and a sweet taste. It is a compound of methane (marsh gas) with iodine and contains about 97% of iodine.

Action: Applied to the skin, to wounds or mucous membranes, iodoform acts as a mild antiseptic and disinfectant. It absorbs the fluids from the wound and in this way it prevents the growth of bacteria. Iodoform is very soothing to the skin or mucous membranes.

— Poisonous Effects

Iodoform is often absorbed into the blood from wounds or sinuses, especially when the surface of the wound is very extensive. This is more apt to occur in adults or susceptible individuals. It produces the following characteristic poisonous symptoms:

1. In mild cases there may be only a rise of temperature; 104° to 105° F. Headache, dizziness, very rapid pulse and loss of appetite also occasionally occur.

In severe cases the following symptoms may also occur:

2. The patient feels depressed, downhearted, even melancholy.
3. Hallucinations (ideas of being persecuted and attempts at suicide).
4. Delirium, even mania.
5. Collapse, which may cause death.

The symptoms may last for several hours or days. Occasionally there is no excitement, the patient goes into stupor and dies of collapse.

— Preparations

Iodoform (Iodoformum)	0.03-0.2 Gm.	grs. $\frac{1}{2}$ -iii
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This is used principally externally in wounds and sinuses in the form of iodoform gauze.

➤ **Iodoform gauze** is made by soaking sterile gauze in a solution containing 5-10% of iodoform, 20-15% of glycerine and adding alcohol up to 100 c.c.

➤ **Iodoform Ointment**
(Unguentum Iodoform)

This contains 10% of iodoform.

Aristol
(Thymolis Iodidum)

This is a yellowish brown powder which is used like iodoform but it has a more pleasant odor.

Iocamfen

This is a compound of iodine, camphor and phenol. It is an antiseptic and germicide, and an analgesic. It is used in the treatment of wounds, as a dusting powder or applied with tampons.

➤ BISMUTH PREPARATIONS

There are a number of preparations of bismuth, consisting of bismuth combined with a carbolic-acid derivative, which are used as dusting powders. Bismuth itself is only slightly disinfectant, but because it is insoluble it absorbs the fluid from the wounds and the bacteria are unable to grow. Most of the antiseptic action, however, is due to the phenol derivative.

Preparations

➤ **Bismuth Subgallate** (Dermatol)
(Bismuthi Subgallas)

This is used as an antiseptic dusting powder on wounds. Gauze soaked in bismuth is now frequently used instead of iodoform gauze. Bismuth paste is frequently injected into deep wounds (sinuses) to make them heal more rapidly.

➤ **Bismuth Subcarbolate**
(Bismuthi Subcarbolas)

Airol
(Bismuth Iodosubgallate)

This combines the action of iodoform and bismuth and is odorless.

Thioform
(Bismuthi Dithio Salicylate)
Xeroform
(Bismuthi Tribromphenolas)

} These are used as antiseptic and astringent dusting powders for wounds and various skin diseases.

➤ PICRIC ACID (TRINITROPHEN)

Picric acid, Trinitrophen or Trinitrophenol, is a yellow crystalline powder.

When applied locally it checks the growth of bacteria (antiseptic) and contracts the skin and mucous membranes. It is used in the form of wet dressings on burns and other wounds and occasionally as douches. It is often applied in the form of an ointment.

In large doses it is absorbed from the skin and causes the following poisonous symptoms: a yellow color of the skin and mucous membranes; the urine is also intensely yellow in color. It occasionally causes convulsions and collapse.

→ BALSAM OF PERU (BALSAMUM PERUVIANUM)

Balsam of Peru is a dark-brown syrupy fluid, which does not dissolve in water. It is a balsam which oozes from the trunk of the *Toluifera pereirae*, a tree growing in Central America and India.

Balsam of Peru is used in the form of gauze saturated with the balsam. This is applied to wounds and ulcers as an antiseptic, and to promote healing by increasing the growth of granulation tissue.

When given internally, it acts as an antiseptic in the stomach and intestines, and aids in the expulsion of gas. After absorption it increases the cough and expectoration. Its effect is due to the benzoic acid which it contains.

→ ANTISEPTICS USED FOR MUCOUS MEMBRANE LINED CAVITIES

→ BORIC ACID 4% in hospital

Boric acid or boracic acid is a weak acid formed by the combination of the element boron with hydrogen.

Local action: Applied to the skin or mucous membranes, boric acid checks the growth of bacteria (antiseptic action). It is also soothing to the skin.

Boric acid is rarely used internally, but when it is given, it increases the flow of urine.

Uses: Boric acid is used as an antiseptic for inflamed mucous membranes in the eyes, nose or mouth. It is especially valuable as a mouth wash and gargle because of its mild action, and it is the principal ingredient of most mouth washes. It is also used to irrigate wounds and abscess cavities.

→ Preparations

Boric Acid (Boracic Acid)	0.3-1.0 Gm.	grs. v-xv
(Acidum Boricum)		

For external use 2-5% solutions are employed.

Sodium Borate (Borax)	0.3-1.0 Gm.	grs. v-xv
(Sodii Boras)		

Boroglycerin
(Glyceritum Boroglycerini)

This is a compound formed by heating boric acid in glycerin. It contains 31% of boric acid.

Liquor Antisepticus

This is a compound containing 2% of boric acid, together with benzoic acid, thymol, eucalyptol, oil of peppermint and oil of thyme. It is also marketed under the name of Glyco Thymoline.

Dobell's Solution

This contains $1\frac{1}{2}$ % of sodium borate, carbolic acid, sodium bicarbonate, glycerin and water. It is used as an alkaline gargle and as an antiseptic nasal douche.

Boric Acid Ointment

(Unguentum Acidi Borici)

This contains 10% of boric acid.

Listerine

This is a compound containing $2\frac{1}{2}$ % of boric acid, together with benzoic acid, thymol, eucalyptol, oil of wintergreen, oil of peppermint, tincture of baptista, alcohol and water.

COLLOIDAL SILVER PREPARATIONS

The preparations of silver act as astringents and are slightly antiseptic and germicidal. When silver preparations are prepared by the silver combining with proteins or albumins, colloidal solutions are formed. Such solutions liberate the silver very slowly. A colloidal solution is a thick gelatinous solution. These silver preparations act principally as antiseptics and germicides. They are not irritating and are only slightly astringent. They are principally used as antiseptics on mucous membrane lined cavities such as the conjunctiva of the eye, the nose, the throat and the genito-urinary tract. They are especially effective in gonorrhœal infections.

Preparations

The preparations commonly used may be divided into three groups:

1. The Protargin mild type
2. The Protargin strong type
3. The Collargol type

Protargin Mild Preparations

These preparations have from 19 to 30% of silver, mostly combined with proteins and are therefore not irritating. They are used in from 5 to 50% solutions. They are also soothing and protective to the mucous membranes.

Argyrol

Silver Vitellin

This is a compound of silver oxide and proteins, containing 20-25% of silver. It is used locally as an antiseptic and an astringent to mucous membranes,

in 10-25% solutions; which are not irritating to the tissues. Argylol should be very carefully used, as it stains linen a dark brown color.

Protargin Mild

This is a combination of silver oxide and proteins. It is non-irritating and is used in the same strengths as argylol.

Argyn

This is a colloidal compound of silver oxide and albumin containing about 20 to 30% of silver. It is used in the same strengths as argylol.

Cargentos

This is a 50% albuminous solution of silver with casein. It is used as an antiseptic, in the form of tablets, vaginal tampons, dusting powder, ointment or suppositories.

Solargentum

This is a compound of silver and gelatin containing 19 to 23% of silver.

Vargol

This is a compound of silver and gelatin containing 19 to 23% of silver. It is used in the same strengths as argylol.

Silvol

This is a compound of colloidal silver with an alkaline protein containing about 20% of silver. It is used in the same strengths as argylol.

Neosilvol 1% - 15%

This is a colloidal combination of silver iodide with a protein, containing 20% silver iodide. It is used in the same strengths as argylol.

Lunosol

This is a colloidal preparation of silver chloride containing about 10% of silver chloride. It is used in strengths of 1:1000 for irrigations and for local applications up to 25 to 50%.

Collene

This is a colloidal silver in a permanent suspension. It is not irritating and does not discolor the skin. It is used in full strength.

Protargin Strong Preparations

These contain from 7 to 8.5% of silver, they are strong germicides; but they are more irritating to mucous membranes. They are used in from $\frac{1}{2}$ to 10% solutions.

Protargol

Protein Silver Salt

This is a compound of albumin and silver containing 8.3% of silver. It is used as an antiseptic, and as an astringent on mucous membranes in 1 to 10% solutions; as irrigations in 1-1000 to 1-2000 and in the form of bougies and tampons in 5-10% solutions.

Protargin Fortius

This is a combination of silver and protein containing 7 to 7½% of silver, which is not irritating. It is used in the same strengths as protargol.

Proganol

This is a compound of silver and albumose containing 8.3% of silver. It is used in the same strengths as protargol.

Collargol Preparations

These preparations contain about 78% of silver. They contain a larger proportion of metallic silver and less of silver combined with protein. They are used principally in 1-500 to 1% solutions and are frequently given by direct injection into the veins.

Collargol (Colloidal Silver Credé)	0.06 Gm.	gr. i
(Collargolum)		

This is a solution of very finely divided silver, in albumin, containing about 85% of silver. It is used as an antiseptic both locally, and injected into the blood.

It is often given by direct injection into the veins, in cases of sepsis, in ½% solutions. It is also used in the form of bougies, vaginal suppositories and dusting powders.

Collargol Ointment
(Unguentum Credé)

This contains 15% of collargol. It is used principally in acute mastitis, or inflammation of the breast. About 2.0-4.0 Gms. (grs. xxx-3i) are rubbed thoroughly on the skin.

EUCALYPTOL

Eucalyptol is a substance obtained from the oil of eucalyptus and other volatile oils. The oil of eucalyptus is the active volatile oil of the *Eucalyptus globulus*, or **blue gum tree**, which grows in southern countries and has the peculiar quality of absorbing moisture from the soil. It is therefore used to drain swamps, and it helps to purify a malarial district in this way; since mosquitoes develop in swampy regions.

It acts as an antiseptic principally on mucous membranes.

It is used in the treatment of malaria, as an intestinal antiseptic, and is inhaled in lung abscesses and fetid bronchitis.

Eucalyptol	0.3-1.0 c.c.	m. v-xv
Oil of Eucalyptus	0.3-1.0 c.c.	m. v-xv

CRESATIN

This is a chemical compound made from cresol. It is an excellent antiseptic and relieves pain at the same time (analgesic action). It has a penetrating odor, and it does not irritate the tissues. It is used as a local application in the throat, in the nose, and in the ears. It is used in full strength or as a spray dissolved in alcohol or in an equal part of oil.

IZAL

This is an emulsion containing about 50% of the liquid obtained from the destructive distillation of bituminous coal. It is used as a germicide and disinfectant for gargles and douches in 1: 300 and 1: 200 solutions.

NEW AND NON-OFFICIAL ANTISEPTICS

ACRIFLAVINE

Acriflavine, proflavine and trypaflavine are complex chemical substances prepared from acridine, which is a substance obtained from coal tar. All these substances have a yellow color.

Although originally used for infections caused by a specific organism, the trypanosome, which causes African sleeping sickness, they are now used extensively as antiseptics.

Action: Acriflavine and proflavine are strong antiseptics, which are not injurious to the tissues and promote healing. The antiseptic property is not weakened by the serum of the blood, which usually weakens other antiseptics.

Uses: Acriflavine is used in solutions and in ointments, especially in gonorrhœal infections, although it has been used with success in other infections. It is used in 1: 5000 to 1: 1000 solutions prepared with physiological salt solution. It is used for dressings and for irrigating wounds. It is also used as a 1% ointment. In gonorrhœa or for rectal irrigations, it is used in 1: 6000 to 1: 1000 solutions.

Acriflavine has recently been used in septicemia by direct injections into the veins in $\frac{1}{2}$ % solutions. Neutral Acriflavine is the preparation used because it is neutral in reaction and therefore not irritating to the skin.

Preparations

Neutral Acriflavine
(Acriflavina Neutra)

Proflavine
(Proflavina)

MERCUROCHROME 220 SOLUBLE

Mercurochrome is a complex salt of mercury, bromine and fluorescein, which contains 23 to 24% mercury. It acts rapidly as a strong germicide. It is used principally in infections caused by the Colon bacillus and the Staphylococcus aureus. It is used for bladder irrigations in gonorrhœal infections in 1 to $2\frac{1}{2}$ % solutions. In infections of the bladder it is used in 1% solutions. It is used in the eye in $2\frac{1}{2}$ % solutions.

It has recently been used effectively by direct injection into the veins in cases of septicæmia, since it does not coagulate the albumin of the blood. About 10 to 30 c.c. of a $\frac{1}{2}$ to 1% solution is usually given for this purpose. The quantity given varies with the patient. Because it is a mercury preparation it is irritating to the kidneys and may cause bloody urine or albumin in the urine, nausea, vomiting and diarrhœa. Since it is eliminated by the kidneys, it is also given by injections into the veins for septic infections of the kidneys.

GENTIAN VIOLET

Gentian Violet is an organic dye made from coal tar. It is a strong antiseptic. Since it is excreted in the urine, it has been used in cases of Staphylococcus infections of the kidney. It is also given intravenously in cases of sepsis due to the Staphylococcus. When given by direct injection in the veins it occasionally causes, in weak patients, cyanosis, a slow pulse and low blood pressure, often requiring cardiac stimulants. It is usually given in a 1% solution. The quantity given varies with the weight of the patient. It is used for cystitis in 1 to 2% solutions.

CHAPTER V

ASTRINGENTS

Astringents are drugs which are used to ⁽¹⁾contract the tissues with which they come in contact. If they are applied to mucous membranes, by contraction of the cells, ⁽²⁾they lessen the secretions.

Astringents affect the tissues only locally, by combining with the proteins or albumins of the cells and thereby coagulating and hardening them. Such an effect can only be produced when the substance comes in direct contact with the tissues upon which it acts.

In large doses, the excessive coagulation of the proteins of the cells destroys the tissues; this effect is called caustic action.

Astringents may be divided into two groups, depending upon the nature of the substance used for this purpose:

Inorganic or Mineral Astringents
Organic or Vegetable Astringents

INORGANIC OR MINERAL ASTRINGENTS

Mineral astringents are mineral substances which are used to contract tissues and to check the secretions of mucous membranes. Most of these substances are metals and their salts. Some of the preparations are also antiseptics and germicides. The principal salts used for this purpose are the salts of **lead, silver, aluminum, zinc, copper and bismuth**. **Mercury, iron and arsenic** are also astringents, but these are used principally for their effects after absorption. The metals usually act by coagulating the albumins of the cells, forming an albuminate of the metal. Many of their preparations are already combined with albumins. These are not as irritating to the tissues and are milder in action.

The best astringents are those that are not readily absorbed, such as **silver, bismuth, copper and zinc**. The two latter substances are the most active astringents. In strong solutions they destroy the tissues.

The metals that are readily absorbed are **mercury, iron, arsenic and lead**. Lead is the only one that is used as an astringent.

gent, the others are used principally for their effects after absorption. Of the various salts of the metals, the chlorides and the nitrates have the most astringent action, while the effect of the sulphates and other salts are not as marked.

ACTION

Local action: Applied to the skin, solutions of the metallic astringents produce no effect, but on ulcers or wounded surfaces they coagulate the albumins of the superficial layer of cells, thus contracting them. In this way, they form a thin coating of coagulated albumin, which protects the cells from injury and promotes healing. If applied to a bleeding spot, they stop bleeding by coagulating the albumins of the blood. **Mucous membranes** are contracted, and their secretions checked, by coagulation of the albumins of their cells.

Internal Action

In the mouth: They have a sweet metallic taste, and make the mouth feel dry by contracting the mucous membrane.

In the stomach and intestines: They check the secretions and lessen peristalsis, thereby causing constipation. They combine with the protein of the food which is then not as readily digested.

Absorption

The mineral astringents combine with the albumins in the stomach and intestines, forming albuminates.

If the resulting compounds can be dissolved in the albuminous fluids which surround them, the metals will be readily absorbed, otherwise they merely act locally. They do not produce any effects, however, unless given for a long time, when they may be deposited in the various tissues of the body and serious poisonous symptoms may develop from some of them. These symptoms will be considered under the various substances from which they occur.

Poisonous Effects of Metallic Salts

When large doses of the salts of any of the metals are taken, the following symptoms occur:

1. Burning pain in the mouth. The mouth may be covered with a grayish white membrane, especially after taking silver preparations.
2. Severe abdominal pain.
3. Nausea and vomiting. Often the vomited matter contains blood.
4. Diarrhoea, with bloody stools.
5. Collapse.
6. Coma and death.

Treatment

→ 1. Wash out the stomach.
 → 2. Give milk, egg white or old tea to combine with the metal and neutralize it. These substances protect the mucous membrane of the oesophagus and stomach at the same time.

3. The collapse is usually treated with stimulants.

4. Give the chemical antidote.

The following is a list of the chemical antidotes for some of the metals, for the others there is no chemical antidote.

Metal	Antidote
Lead	Dilute sulphuric acid
Silver nitrate	Sodium chloride (salt)
Alum	Magnesium hydrate or Ammonium carbonate

METALS

SILVER (ARGENTUM)

Silver is a white, hard, glistening metal. The only salt of silver which is used to any extent in medicine is silver nitrate.

Silver has been used in medicine for centuries, particularly by the Arabians, who used it extensively in the treatment of nervous diseases. In their system of medicine, which was based upon astrology, silver and nervous diseases were associated with the phases of the same planet, the moon; hence the name lunar caustic for silver nitrate.

Uses

Silver salts are used to check excessive granulation tissue (newly formed connective tissue) and to contract the mucous membranes of the eye, the nose, or the mouth when these are inflamed.

The salts of silver are particularly valuable in the treatment of gonorrhœal infections. They destroy the gonococci, the bacteria which cause the disease.

Chronic Silver Poisoning ("Argyria")

Argyria is a condition which results from prolonged use of silver salts, but the condition is not very common at the present time.

The silver salts are absorbed into the blood and deposited in the various tissues of the body. Since silver salts turn a dark color on exposure to light, the skin turns a dark gray or slate color. The skin of the entire body or only various parts of it, such as the face, or the gums, may be thus affected.

To relieve the condition potassium iodide is usually given, but it is not very effective, however.

Preparations

The preparations of silver are divided into inorganic and organic preparations. The inorganic preparations are the ordinary salts formed by the combination of silver with a mineral acid. The organic preparations are formed by the combination of silver with albumin or protein.

Inorganic Preparations

Silver Nitrate 0.01-0.03 Gm. gr. $\frac{1}{8}$ - $\frac{1}{2}$
(Argenti Nitras)

This is used in 1 to 2% solutions dropped in the conjunctiva of the eye, in newly born infants, to prevent gonorrhoeal ophthalmia. In other gonorrhoeal infections and for other conditions, it is used in much weaker solutions, such as 1-10000 to 1-1000.

Silver nitrate forms an explosive compound with tannic acid.

Moulded Silver Nitrate (Lunar Caustic).
(Argenti Nitras Fusus)

This frequently comes in small sticks with silver nitrate tips like match sticks.

Silver Citrate

This is a non-irritating antiseptic. It is used in solutions of 1:4000 to 1:10000 for injections into the urethra and cavities.

Silver Lactate

This is used in 1:100 to 1:2000 solutions for disinfecting purposes.

ALUMINIUM AND ALUM

Aluminium is a light metal. The only salt of aluminium which is used in medicine is the aluminium and potassium sulphate, or alum.

Uses.—Alum is used principally as an astringent to contract mucous membranes.

It is used as a gargle in 1 to 5% solutions. For douches, and as a lotion on the skin and other mucous membranes, it is used in $\frac{1}{2}$ -1% solutions.

Large doses of alum are occasionally used to produce vomiting.

Preparations

Alum 0.3-1.0 Gm. grs. v-xv
(Alumen)

This is aluminium and potassium acetate. Alum is very injurious to the teeth, and when given internally it should be given through a glass tube.

Dried Alum or Burnt Alum
(Alumen Exsiccatum)

This is alum which has been dried by heat. It absorbs moisture from the air. It is often combined with 1-5 parts of alcohol to harden the skin and prevent bedsores.

The other salts of aluminium, such as the aluminium acetate and the aluminium chloride, are used as antiseptics.

Solution of Aluminium Acetate
(Liquor Aluminii Acetas)

(Burow's solution)

This is used in $\frac{1}{2}$ -2% solutions as an antiseptic dressing.

Alumol**Aluminii Naphtholsulphonas**

This is used as an astringent and mild antiseptic, in $\frac{1}{2}$ -5% solutions, for dressings, gargles, douches, etc. It is used as a caustic in 10-20% solutions.

LEAD (PLUMBUM)

Lead is a heavy metal which forms salts by combining with acids, many of which are used in medicine.

Uses

Lead salts are used principally on ulcers and wounds, to contract the tissues, and to check bleeding. The lead acetate is occasionally given to check diarrhoea.

Chronic Lead Poisoning

Chronic lead poisoning is the most common form of poisoning by metals. It occurs particularly in workers who are forced to handle lead or its salts, such as white lead or type, continuously. Painters, typesetters, plumbers and glaziers are frequently affected, the lead being absorbed from the skin, or from the stomach or intestines when it gets on the food from the hands.

Occasionally, lead poisoning results from drinking water coming through lead pipes, or eating canned food from cans soldered with lead, or from food adulterated with lead; such as cakes colored with chromate of lead, etc. It may also occur from inhaling lead fumes in a room painted with lead paint, and from the absorption of ointments or solutions applied to wounds or ulcers.

The symptoms appear very slowly and vary in different individuals. They result from the lead affecting the alimentary tract, the blood and the nerves.

Symptoms

1. Loss of appetite, nausea, metallic taste in the mouth, and bad breath.
2. **"Lead line" on the gums.** This is a dark blue line of lead sulphide which is deposited at the junction of the gums and teeth. It may be absent if the teeth are kept very clean.

3. **"Lead Colic"** or painter's colic.

This is a very characteristic symptom, and usually appears suddenly. The patient complains of severe cramp-like abdominal pains, usually beginning around the navel, and lasting for several days, after which they disappear but soon return.

4. **Obstinate constipation.**

5. Occasionally, vomiting.

If the condition is of long standing, a **severe anaemia** may be produced and the red blood cells are reduced in numbers and many of the cells contain small fine granules.

A number of symptoms due to affection of the nervous system may occur later, such as paralysis of the hands or feet, drop wrists or drop feet, and loss of sensation in the extremities.

Rarely, headache, dizziness, sleeplessness and delirium may result. This is known as **Lead encephalopathy**.

Chronic nephritis and arteriosclerosis (hardening of the arteries) may be produced by lead in individuals who are constantly in contact with lead preparations, such as painters and typesetters.

Treatment

1. Individuals who are continually exposed to lead or its salts can often avoid poisonous symptoms by keeping their hands and nails scrupulously clean, especially before eating, to avoid getting the lead particles in the mouth. They should move the bowels regularly, best by Epsom salt, and they should take dilute sulphuric acid in lemonade regularly. Their diet should contain plenty of milk.

The patients suffering from an attack of chronic lead poisoning are treated in the following way:

1. The bowels should be moved regularly by magnesium or sodium sulphate, which also helps to neutralize the lead, forming lead sulphide, which is then excreted in the intestines.

2. Potassium iodide is given, which helps to eliminate the lead.

3. The lead colic is best controlled by atropine.

4. For the anaemia, iron is given.

5. The paralyses usually get well if carefully treated with electricity and massage.

Preparations

➤ **Lead Acetate** 0.06–0.3 Gm. grs. i–v
(*Plumbi Acetas*)
(Sugar of Lead)

For Local Use:

Solution of Lead Subacetate

(*Liquor Plumbi Subacetatis*)

(Goulard's Extract)

This contains about 25% of lead subacetate. It should be diluted, about $3\frac{1}{4}$ being used to a pint of water.

Dilute Solution of Lead Subacetate

(*Liquor Plumbi Subacetas Dilutum*)

This contains 0.4 c.c. of lead subacetate to 1000 c.c. of water, and is used for local applications.

Lead Oleate Plaster

(*Emplastrum Plumbi Oleatis*)

(Diachylon Plaster)

This consists of lead oxide, soap and water.

➤ Adhesive Plaster

(*Emplastrum Adhæsivum*)

This consists of rubber, lead plaster, and vaseline.

Soap Plaster

(*Emplastrum Saponis*)

This consists of soap, lead plaster and water.

Diachylon Ointment or Ointment of Lead Oleate
(Unguentum Diachylon) (Unguentum Plumbi Oleatis)

This consists of lead plaster, olive oil and oil of lavender.

ZINC (ZINCUM)

Zinc is a metal, and many of its salts are used in medicine.

Uses.—Zinc sulphate is used to produce vomiting. The other zinc salts are used as astringents in various skin diseases and ulcers.

Zinc Poisoning.—Chronic zinc poisoning occasionally occurs among workers who handle zinc. It causes symptoms like those of lead poisoning.

Preparations

Zinc Sulphate (as an emetic) 0.3–2.0 Gms. grs. v–xxx
(Zinci Sulphas)

It is used as an eye wash in $\frac{1}{4}$ – $\frac{1}{2}$ % solutions and as an injection in gonorrhoea in 1–4% solutions.

Zinc Oxide
(Zinci Oxidum)

Zinc Oxide Ointment
(Unguentum Zinci Oxidum)

This contains 1 part of zinc oxide to 5 parts of benzoinated lard. It is the most commonly used preparation and is used to relieve itching.

Precipitated Zinc Carbonate
(Zinci Carbonas Precipitatus)

Zinc Stearate
(Zinci Stearas)

This is used as a dusting powder on ulcers, and on various skin diseases.

Zinc Stearate Ointment
(Unguentum Zinci Stearas)

This contains 50% of zinc stearate.

Zinc Chloride
(Zinci Chloridum)

This is a white powder which is moulded into pencils. It is used to destroy tissues (caustic action). It is an ingredient of many "cancer cures," and is applied as an ointment to destroy the cancerous tissue.

Solution of Zinc Chloride
(Liquor Zinci Chloridum)

This contains about 36% of zinc chloride, and is used as a disinfectant for sinks and toilets.

Calamine Lotion

This contains a mixture of zinc oxide, glycerin, lime water, rose water and

calamine. Calamine is an impure carbonate of zinc. The preparation is used for skin diseases.

→ COPPER (CUPRUM)

Copper is a metal, many salts of which are occasionally used as drugs.

Preparations

→ Copper Sulphate or Cupric Sulphate (blue vitriol or blue stone)

(Cupri Sulphas)

as an astringent 0.015–0.12 Gm. grs. $\frac{1}{4}$ –ii

as an emetic 0.3–0.6 Gm. grs. v–x

It is used principally to remove the granulations which form in the eyelids in trachoma, an infectious disease of the eyelids.

It is also used to produce vomiting, as an astringent, and occasionally to destroy tissue (escharotic action).

→ ALKALINE ASTRINGENTS

→ BISMUTH (BISMUTHUM) *used in diarrhoea*

Bismuth is a crystalline metal. Many of its insoluble salts are used as medicines.

Uses

Bismuth salts are used as dusting powders on the skin, as astringents, as antiseptics and to promote healing of ulcers, and sinuses.

They are principally used to coat, protect and heal ulcers of the stomach, and as an astringent to check diarrhoea. They are often used to lessen nausea and vomiting. The stools usually turn black when bismuth is being given. This is due to the formation of bismuth sulphide.

Large quantities of bismuth pastes are often given to coat the mucous membranes of the oesophagus, stomach and intestines so as to enable an X-ray picture to be taken. The bismuth is not penetrated by the X-rays, and the organ containing the bismuth produces a dark shadow on the picture.

Poisonous Effects

Bismuth poisoning occasionally results when it is used for a long time; especially in the form of dressings. Such applications are more apt to cause poisonous symptoms than its internal administration.

Symptoms

The following symptoms, which resemble those of mercury poisoning appear very slowly:

1. Profuse flow of saliva.
2. A blue line at the junction of the gums and teeth.
3. Swelling of the gums, tongue and throat, often with destruction of the soft palate, and other portions of the mucous membrane of the mouth.
4. Vomiting and diarrhoea.
5. Albumin in the urine.

The symptoms usually disappear when the dressings are removed.

Preparations

→ **Bismuth Subnitrate** 0.3-2.0 Gms. grs. v-xxx
(Bismuthi Subnitratis)

→ **Bismuth Subcarbonate** 0.3-2.0 Gms. grs. v-xxx
(Bismuthi Subcarbonatis)

Crema Bismuthi 4.0-16.0 c.c. ℥i-iv
(Mistura Bismuthi Subcarbonatis Hydrati)

Lac Bismuthi 4.0-16.0 c.c. ℥i-iv
(Mistura Bismuthi)

This is a mixture of bismuth hydroxide and bismuth subcarbonate.

Tannismuth 0.3-0.6 Gm. grs. v-x
(Bismuthi Bitannas)

This contains about 17 to 21% of bismuth.

Bismuth and Iron Citrate 0.3-0.6 Gm. grs. v-x
(Bismuthi et Ferri Citras)

This is used for anaemia with gastric disturbances.

Bismuthal

This is a mixture of pepsin, hydrochloric acid, and bismuth.

→ **Bismuth Subgallate (Dermatol)** 0.3-1.3 Gm. grs. v-xx
(Bismuthi Subgallas)

This is used principally as a dusting powder on wounds.

Airol (Bismuth Iodosubgallate)
(Bismuthi Iodosubgallas)

This is a combination of bismuth oxyiodide and gallic acid. It liberates iodine and is used as a local application to wounds, in 10% solutions in glycerin or in a 10 or 20% ointment.

Xeroform 1.0-3.0 Gms. grs. xv-xlv
(Bismuthi Tribromiphenolas)

This is used principally as an antiseptic in ulcers of the leg, eczema, and as an intestinal antiseptic, for diarrhoea and as a substitute for iodoform.

→ **CERIUM OXALATE**

Cerium oxalate is a salt of cerium, a crystalline metal, which resembles bismuth. It is used to check vomiting; in pregnancy, sea-sickness, and in other conditions.

Cerium Oxalate 0.12-0.6 Gm. grs. ii-x
(Cerii Oxalas)

BARIUM

Barium is a crystalline metal. The only salt commonly used in medicine is barium sulphate. A paste made with this salt is used to coat the stomach and intestines for taking X-ray pictures.

— \ POTASSIUM CHLORATE

Potassium chlorate is a white crystalline powder which has a cool salty taste. Its effects are due to the chlorine part of the salt.

Applied to the skin or mucous membranes, potassium chlorate contracts the tissues and acts as an astringent. It is therefore used to relieve inflammation of ulcerated surfaces or mucous membranes. It is frequently used as a gargle for sore throat and for ulcerations of the mouth following mercury poisoning. When absorbed, it increases the flow of urine, but it is seldom given for this effect, because of its poisonous action.

Potassium Chlorate Poisoning

This condition usually results when a potassium chlorate gargle is swallowed by mistake. The symptoms are due to the formation in the blood of methaemoglobin, a form of haemoglobin which does not combine with oxygen; and the red corpuscles are then unable to carry oxygen to the tissues. At the same time potassium chlorate injures the kidneys, producing symptoms of nephritis.

Symptoms

1. Abdominal pain.
2. Profuse vomiting and diarrhoea (the vomited matter contains bile or blood).
3. Scanty urine, which may contain haemoglobin and methaemoglobin (this gives the urine a transparent red color).
4. Jaundice, with small haemorrhages into the skin.
5. Cyanosis.
6. Muscular twitchings, convulsions.
7. Coma, collapse.

Treatment

The treatment consists of washing out the stomach and giving heart stimulants. The condition is best relieved, however, by removing a quantity of blood from a vein (and thereby a quantity of the methaemoglobin) and replacing it by an intravenous infusion of normal salt solution.

Preparations

Potassium Chlorate	0.06–0.3 Gm.	grs. i–v
(Potassii Chloras)		

It is used in 4–6% solutions as a gargle.

Troches of Potassium Chlorate. Each contains 0.3 Gm. (grs. v).
(Trochisci Potassii Chloratis)

Sodium Chlorate	0.06–0.3 Gm.	gr. i–v
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This has the same action as potassium chlorate.

— \ VEGETABLE OR ORGANIC ASTRINGENTS

Vegetable astringents are vegetable substances whose principal effect is to contract the tissues and lessen the secretion of

the mucous membranes. The effects are due to an organic acid, **tannic acid**, which they contain.

→ TANNIC ACID OR TANNIN

Tannic acid is an organic acid found in a great many vegetable substances. It is obtained from powdered **nutgall** or **oak gall**. This is a vegetable growth produced in the bark of an oak tree, the **Quercus lusitannica**, dyers' oak, or gall oak. The growth results when a species of fly (the *Cynips gallae tinctoriae*) punctures the bark and deposits its eggs at the site of puncture.

There are various forms of tannic acid, according to the plant from which they are obtained; for example, **gallotannic acid**, from nutgall; **kinotannic acid**, from kino; **catechutannic acid**, from catechu, etc.

Tannic acid is very closely related to gallic acid, which is tannic acid combined with water.

ACTION

The action of tannic acid is due to the coagulation of the proteins of the cells with which it comes in contact.

Local action: Applied to the skin, to a wounded surface or to an ulcer, tannic acid contracts the tissues by coagulating or hardening their cells. If applied to a bleeding point, it stops the bleeding by coagulating the proteins of the blood. **On mucous membranes:** It checks the secretion by contracting the cells.

When given by mouth it contracts the mucous membrane of the stomach and intestine, acting as an astringent.

Uses

Tannic acid preparations are used principally:

1. To check excessive secretion of the alimentary tract, in diarrhoea.
2. To check inflammation and excessive secretion and swelling of mucous membranes, such as diseased conditions of the mouth or throat.
3. To prevent bedsores by hardening the skin.
4. As an antidote to various metallic and alkaloid poisons.
5. It is often given as an astringent irrigation in the colon and vagina.

Poisonous Effects

Tannic acid is not a strong poison. Large doses, by severe irritation of the mucous membrane of the alimentary tract, often cause nausea, vomiting and diarrhoea.

Administration

For a local effect it is used in the form of an ointment or as a lotion in 5 to 20% solutions.

For its effect in the stomach, it is best given in powder form.

For its effect in the intestines, it is best given in pill form.

Preparations

Tannic Acid (Acidum Tannicum)	0.12-0.6 Gm.	grs. ii-x
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Troches of Tannic Acid (Trochisci Acidi Tannici)	0.06 Gm.	gr. i
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For Local Use:

Glycerite of Tannic Acid
(Glyceritum Acidi Tannici)

This contains 20% of tannic acid.

Tannic Acid Ointment
(Unguentum Acidi Tannici)

This contains 20% of tannic acid.

Styptic Collodion
(Collodium Stypticum)

This contains 20% of tannic acid.

New and Non-Official Preparations

The following preparations are not so apt to cause nausea and vomiting and are milder in their action.

Tannalbin or Albutannin	0.3-1.0 Gm.	grs. v-xv
Tannin Albuminate (Albuminas Tannas)		

This is a compound of tannic acid and albumin and is used to check diarrhoea. It is not dissolved in the stomach and acts only in the intestines.

Tannigen or Acetannin	0.2-0.6 Gm.	grs. iii-x
Tannyl Acetate (Acidum Tannicum Diacetylicum)		

This is used to check diarrhoea and acts in the intestine when it comes in contact with the intestinal juice. It is slowly dissolved.

Tannoform	0.25-0.5 Gm.	grs. iv-viii
(Tanninformaldehydum)		

This is a compound of gallotannic acid with formaldehyde. It is an astringent and antiseptic and is used to check diarrhoea.

It is also used locally as a powder in 25% to 50% solutions or as a 10% ointment for eczema, profuse sweating, etc.

Tannopin or Tannon	0.3-0.5 Gm.	grs. v-viii
Hexamethylene Tetramine Tannin		

This is used as an astringent and as an antiseptic in the intestines in chronic colitis, tuberculous enteritis, etc.

Protan	1.0-2.0 Gms.	grs. xv-xxx
Tannin Nucleo Protein	For children, 0.3-0.6 Gm.,	grs. v-x

This is a compound of casein and tannic acid, containing 50% of tannic acid. It is rapidly dissolved, acts on the upper part of the intestine, and is used to check diarrhoea.

Tannacol	1.0-2.0 Gms.	grs. xv-xxx
Gelatine Tannate		

This is used to check diarrhoea.

GALLIC ACID

Gallic acid is an organic acid which is usually made from tannic acid by its combination with water.

It does not coagulate albumins, and it has a milder action than tannic acid. It is more readily absorbed into the blood, and is only used to check excessive secretion of sweat, of bronchial mucus and to check bleeding from the lungs or kidneys, but it is not very effective.

Gallic Acid	0.3-2.0 Gms.	grs. v-xxx
(Acidum Gallicum)		

Gallogen, ellagic or benzoaric acid is an acid obtained from the pods of the divi divi plant or *Coesalpinia coraria*.

It checks diarrhoea and contracts mucous membrane.

It is given in doses of 0.6-1.0 Gm. (grs. v-xv).

VEGETABLE SUBSTANCES CONTAINING TANNIC OR GALLIC ACIDS

Galla (Nutmall)

Galla or nutgall is a growth which forms on the bark of the *Quercus infectoria*, or gall oak tree, when it is punctured by a species of fly (*Cynips tinctoria*) which deposits its eggs in the puncture. Before the larvæ are formed from the eggs, the galls contain about 50% of tannic acid and smaller quantities of gallic acid.

Nutmall contracts the tissues and checks the secretion of mucous membranes because of the tannic acid which it contains. It is little used except in the form of an ointment, as a local application for hæmorrhoids.

Tincture of Nutgall	2.0-12.0 Gms.	grs. xxx-℥iii
(Tinctura Gallæ)		

Nutmall Ointment
(**Unguentum Gallæ**)

Gall and Opium Ointment
(**Unguentum Gallæ cum Opii**)

This contains 7½% of opium.

Gambir

Gambir or pale catechu is an extract made from the leaves and twigs of *Ouraparia gambir*, an East Indian shrub. It is used as a powerful astringent.

gent; contracting the tissues and checking the secretions of mucous membranes, because of the tannic acids which it contains.

Krameria (Rhatany)

Krameria is obtained from the roots of **Krameria triandra**, Para rhatany, and of **Krameria Ixima**, Peruvian rhatany, two South American shrubs.

They are powerful astringents, contracting the tissues and checking the secretions, because of the tannic acid which they contain.

Kino

Kino is the dried juice of the **Pterocarpus marsupium**, an East Indian tree.

It is a strong astringent, contracting tissues and checking the secretions of the mucous membranes, because of the tannic acid which it contains.

Hamamelis (Witch Hazel)

Hamamelis, or witch hazel, is obtained from the leaves, bark and twigs of **Hamamelis virginiana**, an American plant. It contains tannic acid and a volatile oil.

It contracts the tissues and checks the secretions of mucous membranes. It is used to check bleeding and to lessen inflammations.

Extract of Witch Hazel (Aqua Hamamelis)

8.0 c.c.

℥ii

This is a colorless alcoholic fluid made by distilling the leaves and twigs of witch hazel. It contains very little tannic acid and a volatile oil.

Rubus (Blackberry)

Rubus or blackberry is the bark of the roots of various species of the blackberry plant, such as **Rubus villosus**, **Rubus canadensis** and **Rubus trivialis**.

It is used as an astringent to contract the tissues and check the secretions of mucous membranes, because of the tannic acid which it contains.

Blackberry brandy is a common household remedy used to check diarrhoea.

Rhus Glabra (Sumach)

Rhus glabra is obtained from the fruit of **Sumach berries**. It contains tannic and mallic acids.

It is used as an astringent gargle, diluted in two parts of water, for sore throat and pharyngitis.

Rosa or Rosa Gallica (Rose or Red Rose Petals)

Rosa gallica is made from red rose petals, gathered from the unopened buds.

It is used as a mild astringent and as a flavoring ingredient.

It usually comes in the form of a fluid extract, a honey, a syrup, and a confection, for flavoring purposes.

For local use, the following preparations are used:

Rose Water
(Aqua Rosae)

Cold Cream or Rose Ointment
(Unguentum Aqua Roseae)

Camellia Thea (Tea Plant)

Tea leaves contain large amounts of tannic acid. If they are boiled for a long time, and the leaves then squeezed out the resulting fluid contains large amounts of tannic acid.

Myrrh (Myrrha)

Myrrh is a gum resin obtained from the *Commiphera Myrrha*, an American tree. Its active principle is a resinous substance.

It contracts the skin and mucous membranes and is slightly disinfec-
tant. It increases the secretions and is said to increase menstruation.

It is used principally as an astringent; in inflammations of the gums as in mercury poisoning, and as an ingredient of many cathartics.

Tincture of Myrrh	2.0-4.0 c.c.	$3\frac{1}{2}$ -i
(Tinctura Myrrhae)		

Chamomile, Jambul, and many of the vegetable substances used as bit-
ters, contain large amounts of tannic acid, and have, therefore, an astringent
action.

CHAPTER VI

THE PREPARATION OF DOSES

Most drugs are poisons—they are harmful to the body. In fact some of them may even cause death if given in sufficiently large quantities. They injure the body by making one or more organs excessively active (overstimulation), by lessening activity to a very marked degree (excessive depression), or by injuring the cells (irritation).

We take advantage of the changes which drugs cause in the activity of organs or tissues and utilize the drugs in the treatment of disease to produce desired effects.

Beneficial and poisonous effects differ only in degree and depend upon the size of the dose given. Thus a small quantity of a substance will produce beneficial effects, while a larger one may cause poisonous effects.

DOSAGE

By experiments on animals we can determine the smallest quantity of a drug that must be given to produce any change in the activity of an organ or tissue of the body. This is the smallest or **minimum dose**. By similar experiments we can determine the largest quantity of the same drug which may be given without causing dangerous effects. This is the **maximum dose**. A quantity of a drug which exceeds this maximum dose is called an **overdose** or **poisonous dose**. Such doses may cause dangerous or poisonous symptoms. All drugs have different doses; if several substances happen to have the same dose it is merely a coincidence.

Rule for Dosage

There is no rule whereby the doses of all drugs may be remembered. The dose of each drug must be memorized. The following rule, however, will facilitate remembering the principal preparations of the common potent drugs such as opium, nux vomica, belladonna, digitalis, etc.

The dose of the **crude** drug is **gr. i** or **0.065 Gm.**

Fluidextracts represent 100% of drug, therefore the dose is the same as the crude drug, but in fluid measure: **m. i** or **0.065 c.c.**

Tinctures are 10% solutions; they are one-tenth as strong as the drug, therefore the dose is 10 times that of the crude drug but in fluid measure; of the potent drugs it is usually **m. x** or **0.065 c.c.**

Extracts are concentrated solid preparations which are about 4 times as strong as the crude drug; therefore the dose is $\frac{1}{4}$ as much as the crude drug; of the potent drugs it is usually **gr. $\frac{1}{4}$** or **0.015 Gm.**

Conditions Influencing the Dose

Age: An older person usually requires a larger dose than a younger one. Old people and children, however, require smaller doses.

Sex: Males usually require larger doses than females.

Weight: Heavier, stouter individuals usually require larger doses than lighter ones.

Temporary conditions: After a meal more absorption usually takes place, therefore the effects are usually more marked.

Time of Administration: Some substances produce better effects at different times. Thus, drugs which produce sleep cause little effect in the morning and a better effect at night.

Pregnancy: In pregnancy potent remedies should be given in the smallest quantities; since they are apt to cause abortion.

Lactation: In the nursing woman care must be exercised in the doses of many remedies which are eliminated in the milk and may therefore induce poisonous symptoms in the nursing child.

CALCULATION OF DOSES

Potent drugs usually come in the form of tablets of definite doses for hypodermic use. They are frequently put up combined with various other drugs with which they are commonly given. In hospital practice, for reasons of economy, potent substances are often kept in solutions of various strengths. Frequently, however, a dose may be ordered other than that of the usual tablets, or, the nurse may be called upon to give a dose that she cannot readily measure from the solution in stock. In such instances she will have to calculate the dose required either from the tablets of the usual dose or from a stock solution of a definite strength.

CALCULATION OF DOSES FROM TABLETS

Problem: To give a fractional dose from a tablet of a definite strength.

When a dose of a drug is ordered for hypodermic or internal use other than the usual strengths of tablets in stock, the following method will enable the nurse to calculate and prepare the correct dose:

Rule 1. Divide the required dose by the strength of the stock tablet. This gives the fraction of the tablet to be given.

Technique: Dissolve the stock tablet in a quantity of water in which the denominator of this fraction can be divided evenly. Give the patient this fraction of the quantity of water in which the tablet has been dissolved.

If the answer is **more than 1 and a whole number**, then the number of tablets indicated by this number should be given.

If the answer is a **whole number and a fraction**, dissolve one tablet in a quantity of water in which the denominator of the fraction can be divided evenly. Take the fraction of that amount of water and add to it the number of tablets indicated by the whole number.

Example 1: How would you prepare strychnine sulphate gr. $\frac{1}{60}$ from tablets of gr. $\frac{1}{30}$?

According to the rule:

$$\frac{1}{60} \div \frac{1}{30} = \frac{1}{60} \times \frac{30}{1} = \frac{30}{60} = \frac{1}{2}$$

We therefore have to give $\frac{1}{2}$ of the gr. $\frac{1}{30}$ tablet. By dissolving this tablet in m. xx of water (into which 2 can be divided evenly) and giving the patient $\frac{1}{2}$ of that or m. x, we will give the correct dose.

Example 2. How would you give gr. $\frac{1}{120}$ of atropine sulphate from tablets of gr. $\frac{1}{100}$?

The required dose is gr. $\frac{1}{120}$, the stock dose is gr. $\frac{1}{100}$. According to the rule, $\frac{1}{120} \div \frac{1}{100} = \frac{1}{120} \times \frac{100}{1} = \frac{5}{6}$.

We therefore have to give $\frac{5}{6}$ of the gr. $\frac{1}{100}$ tablet.

Since 6 can be divided evenly in m. xxx of sterile water, we dissolve the gr. $\frac{1}{100}$ tablet in 30 minims of water, and give the patient $\frac{5}{6}$ of it or m. xxv.

Example 3. How would you give gr. $\frac{1}{30}$ of strychnine sulphate from tablets of gr. $\frac{1}{50}$?

The required dose is gr. $\frac{1}{30}$, the dose in stock is gr. $\frac{1}{50}$.

According to the rule, $\frac{1}{30} \div \frac{1}{50} = \frac{1}{30} \times \frac{50}{1} = \frac{50}{30} = 1\frac{2}{3}$ tablets.

Since 3 (the denominator of $\frac{2}{3}$) can be divided evenly into 30, we dissolve 1 tablet in m. xxx of water and take $\frac{2}{3}$ of that or m. xx. To this we add another tablet of gr. $\frac{1}{50}$.

Problem: To prepare a necessary number of doses from one or more tablets of another dose.

The nurse is occasionally called upon to prepare a number of doses from one or more tablets of another dose. The following method will enable her to prepare the necessary quantity and to administer accurate doses from this quantity.

Rule: Divide the total quantity of the tablets in stock by the dose to be administered.

The result will be the number of c.c. in which the tablet should be dissolved.

Technique: To administer the correct dose give 1.0 c.c. (m. xv) of this quantity each time.

The tablet may also be dissolved in a number of *minims* indicated by the result, of which m. i is given each time. This method is not as good since it necessitates working with smaller quantities.

Example: The doctor orders the patient to get strychnine sulphate gr. $\frac{1}{300}$ every two hours. The nurse has only one tablet of gr. $\frac{1}{30}$. How many doses can she prepare from the tablet and how should she prepare an accurate dose each time?

There are as many doses as $\frac{1}{300}$ is contained into $\frac{1}{30}$

According to the rule, $\frac{1}{30} \div \frac{1}{300} = \frac{1}{30} \times \frac{300}{1} = \frac{300}{30} = 10$

The tablet should then be dissolved in 10 c.c. of water thus preparing 10 doses. 1.0 c.c. (m. xv) should be given every two hours, since every 1.0 c.c. contains gr. $\frac{1}{300}$.

CALCULATION OF DOSES FROM STOCK SOLUTIONS

In many institutions, for reasons of economy, many potent drugs which are used hypodermically are kept in solutions of various strengths. In most hospitals, however, the use of stock solutions is greatly limited. As a general rule, the more potent substances are kept in weak solutions (1% or less) and the less potent ones in stronger solutions. For example, strychnine sulphate is usually kept in 1% solutions and even in weaker solutions. Solutions of camphor or caffeine usually come in 20% or 25% solutions and even in stronger solutions.

In the calculation of doses from stock solutions the following facts may be emphasized. They are the elements upon which the calculations for such solutions are based.

1. In the following examples, the drop represents the drop obtained from a minim dropper and is therefore equal to **one minim.**

2. The fraction of a grain contained in one drop of a stock solution is always indicated by the percentage or ratio strength of the solution expressed as a fraction. Thus, one drop of a 1% solution contains gr. $\frac{1}{100}$, one drop of a 2% solution contains gr. $\frac{2}{100}$ or gr. $\frac{1}{50}$, one drop of a 20% solution contains gr. $\frac{20}{100}$ or gr. $\frac{1}{5}$, one drop of a 1:30 solution contains gr. $\frac{1}{30}$, etc.

For practical purposes we may classify all stock solutions in two groups:

(a) **Relatively strong solutions.**

(b) **Relatively weak solutions.**

The relatively strong solutions usually contain substances that are administered in rather large doses; such as camphor, given in doses of grs. iii, grs. v, etc., caffeine, given in doses of gr. $\frac{1}{2}$, gr. i, etc.

The relatively weak solutions usually contain very potent substances that are administered in very small fractional doses, strychnine, given in doses of gr. $\frac{1}{60}$, gr. $\frac{1}{30}$, etc., atropine, given in doses of gr. $\frac{1}{120}$, etc.

Problem: To calculate the dose to be given from stock solutions of various strengths.

This may be done by the following two methods:

1. **The Division Method.**

2. **The Least Common Denominator Method.**

Every problem may be solved by either method. Practically, however, the division method is more applicable for the following problems:

(a) Calculation of large doses such as gr. $\frac{1}{2}$, grs. iii, grs. v, etc.

(b) Calculation of doses from solutions in which a given number of minims contain a definite dose; for example, where 1 m. x. contain gr. $\frac{1}{30}$.

The least common denominator method is more applicable for the calculation of small doses from relatively weak solutions, for example gr. $\frac{1}{150}$, gr. $\frac{1}{160}$, etc. For the calculation of such problems the advantage of this method is that it avoids working with fractions of a drop or fractions of a minim.

THE DIVISION METHOD

Rule: Divide the dose required by the fraction of a grain contained in one drop or minim of the stock solution. The result is the number of minims of stock solution to use.

Technique

(1) Pour the number of minims indicated by the result into a medicine spoon.

(2) Add enough sterile water to fill up a hypodermic syringe and give the dose to the patient.

Example: To give strychnine sulphate gr. $\frac{1}{25}$ from a 1% solution.

Since the stock solution is a 1% solution, each drop will contain gr. $\frac{1}{100}$.

$$\text{According to the rule, } \frac{1}{25} \div \frac{1}{100} = \frac{1}{25} \times \frac{100}{1} = \frac{100}{25} = 4$$

We therefore give 4 minims or drops of the 1% solution which contain gr. $\frac{1}{25}$.

Example: To give gr. $\frac{1}{25}$ of strychnine sulphate from a solution of which m. x = gr. $\frac{1}{30}$.

Since m. x = gr. $\frac{1}{30}$, each drop or

$$\text{m. i, will contain } \frac{1}{10} \text{ of } \frac{1}{30} \text{ or gr. } \frac{1}{300}$$

If each drop contains gr. $\frac{1}{300}$, gr. $\frac{1}{25}$ will be contained in as many drops as $\frac{1}{300}$ is contained in $\frac{1}{25}$ or,

$$\text{According to the rule, } \frac{1}{25} \div \frac{1}{300} = \frac{1}{25} \times \frac{300}{1} = \frac{300}{25} = 12$$

We therefore have to give xii of the stock solution, which contain gr. $\frac{1}{25}$.

Example: To give grs. iv of caffeine sodium benzoate from a 25% solution.

Each drop of a 25% solution contains gr. $\frac{25}{100}$, or gr. $\frac{1}{4}$ of caffeine sodium benzoate.

To give grs. iv therefore, we would have to give as many minims as $\frac{1}{4}$ is contained in 4, or,

$$\text{According to the rule, } 4 \div \frac{1}{4} = 4 \times \frac{4}{1} = 16$$

To administer a dose of grs. iv of caffeine sodium benzoate we would give then, m. xvi of the 25% solution.

THE LEAST COMMON DENOMINATOR METHOD

The method may be illustrated by the following concrete example:

To give atropine sulphate gr. $\frac{1}{300}$ from a 1% solution.

Every drop or minim of a 1% solution contains gr. $\frac{1}{100}$. According to the method of division, dividing $\frac{1}{300}$ by $\frac{1}{100}$ we get $\frac{1}{3}$. We therefore have to give $\frac{1}{3}$ of a minim. We cannot obtain, however, the gr. $\frac{1}{300}$ in an even number of minims of the stock solution. We must then prepare another solution from which an even number of minims will contain the gr. $\frac{1}{300}$. This may be done by taking one drop of the 1% solution and adding two drops of water to it, thus diluting it twice. Each drop of such a solution will contain gr. $\frac{1}{300}$, consequently we take one minim of this solution for the desired dose.

By the least common denominator method we may determine in each problem how much a quantity of the stock solution is to be diluted. From this new diluted solution we can obtain the required dose in an even number of minims.

Rule

1. Reduce the smallest fraction of a grain contained in one minim or drop of the stock solution, and the dose to be given, to fractions with a least common denominator.

To Find the Dilution

2. Subtract the numerator of the fraction of a grain contained in a minim of the stock solution, from the numerator of its equivalent fraction.

Add this number of minims of sterile water to one drop of the stock solution.

To Find the Number of Minims of the New Diluted Solution to Use

3. Of this new diluted solution give the number of minims indicated by the numerator of the least common denominator fraction formed from the required dose.

Technique

(1) Draw up some stock solution into a minim dropper, and pour one drop of it into a medicine spoon. (See illustration, Fig. 2.)

(2) To this drop, add as many drops of sterile water as the number of times it is to be diluted, as determined by solving the problem. (See illustration, Fig. 3.)

(3) Draw up some of this diluted solution in a minim dropper, and pour the number of drops needed (as determined by solving the problem) into another medicine spoon. (See illustration, Fig. 4.)

(4) Add enough sterile water to this quantity to fill up the hypodermic syringe, draw the fluid up into the syringe and administer the dose. (See illustration, Fig. 5.)

In giving doses less than that contained in one drop of the stock solution we always dilute **one drop** of the stock solution.

In giving doses greater than that contained in one drop of the stock solution we dilute **more than one drop**. (See page 97.)

The following examples will illustrate the method:

Example: To give gr. $\frac{1}{200}$ of atropine sulphate from a 1% solution.

1. Each drop of the atropine sulphate solution contains gr. $\frac{1}{100}$.

2. The desired dose is gr. $\frac{1}{200}$.

3. The least common denominator of 100 and 200, is 200.

According to the rule,

$$\frac{* \triangle}{100} = \frac{\textcircled{2}}{200} *$$

$$\frac{1}{200} = \frac{\boxed{1}}{200} *$$

One drop of the atropine solution must be diluted with one drop of water, since $\textcircled{2} - \triangle = 1$.

(This makes a solution of which each drop contains gr. $\frac{1}{200}$.)

The number of drops of this diluted solution to use, is indicated by the numerator of $\frac{\boxed{1}}{200}$ formed from the desired dose, gr. $\frac{1}{200}$, which is 1.

We therefore take one drop of the atropine sulphate solution, add one drop of water to it, and from this we take **one drop** of the resulting solution. To this drop, add enough water to fill up a hypodermic syringe and administer to the patient.

Example: To give gr. $\frac{1}{300}$ atropine sulphate from a $\frac{1}{2}\%$ solution.

Each drop of $\frac{1}{2}\%$ atropine solution contains gr. $\frac{1}{100} = \text{gr. } \frac{1}{200}$.

The least common denominator is 600.

According to the rule,

$$\frac{\triangle}{200} = \frac{\textcircled{3}}{600}$$

$$\frac{1}{300} = \frac{\boxed{2}}{600}$$

Then take one drop of the $\frac{1}{2}\%$ atropine solution and add two drops of water ($\textcircled{3} - \triangle = 2$) and take 2 (numerator of $\frac{\boxed{2}}{600}$, which is the same as $\frac{1}{300}$) drops of the resulting solution.

When the dose to be prepared is larger than that contained in one minim of the stock solution:

In doses larger than that contained in one drop of the stock solution, we find, that after taking one drop of the stock solution, and adding the necessary number of drops of water, the total quantity made up is less than the number of drops of the resulting solution to use.

Example: To give gr. $\frac{1}{60}$ of strychnine sulphate from a 1% solution.

Each drop of a 1% solution contains gr. $\frac{1}{100}$ of strychnine. The least common denominator is 300.

According to the rule,

$$\frac{\triangle}{100} = \frac{\textcircled{3}}{300}$$

$$\frac{1}{60} = \frac{\boxed{5}}{300}$$

* $\triangle$ encloses the numerator of the fraction of a grain contained in one drop of the stock solution.

$\textcircled{}$ encloses the numerator of the least common denominator fraction formed from the fraction of a grain contained in one drop of the stock solution.

$\boxed{}$ encloses the numerator of the least common denominator fraction formed from the required dose.

METHOD OF PREPARING DOSES OF MEDICINES FROM STOCK SOLUTIONS



FIG. 1. Apparatus necessary for preparing and administering doses from stock solutions.



FIG. 2. Measuring the number of minims of stock solution.

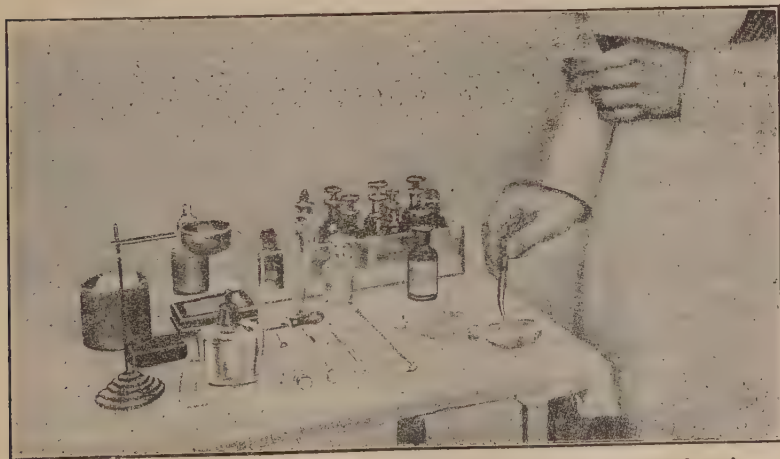


FIG. 3. Adding the necessary number of minims of water, thus forming a new diluted solution.

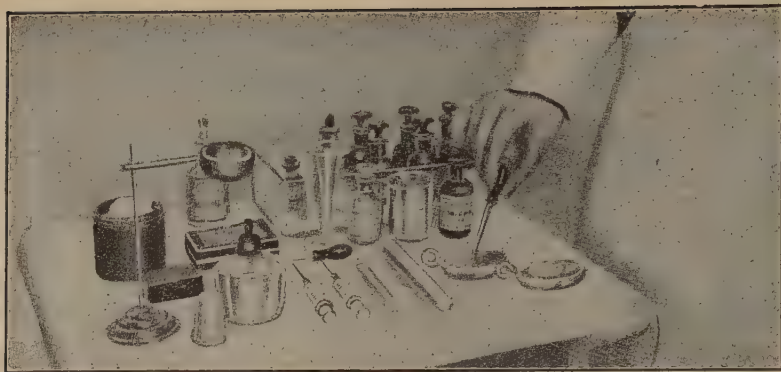


FIG. 4. Measuring the necessary number of minims of the new diluted solution.

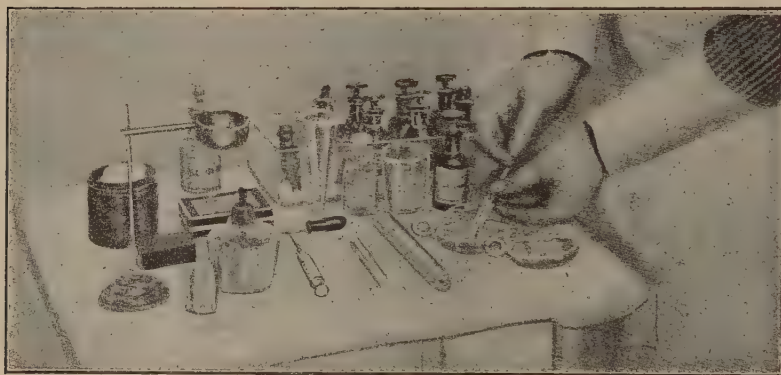


FIG. 5. Drawing up the number of minims to be administered into the hypodermic syringe.



FIG. 6. The correct way to give a hypodermic injection.
(Note the direction of the needle.)



FIG. 7. The wrong way to give a hypodermic injection.

③ - Δ = 2, the number of drops of water to add.

We would then have to take 1 drop of the stock solution, and add 2 drops of water to it. Of this diluted solution we then take $\boxed{5}$ drops. But the total number of drops of the resulting solution is only 3, while the number to be used is 5, more than the total amount.

The object of taking 1 drop of the stock solution, and adding 2 drops of water, is to make up a solution of which each drop shall contain gr. $\frac{1}{300}$ of strychnine, and then, instead of giving gr. $\frac{1}{60}$ of strychnine, we give its equivalent, gr. $\frac{5}{300}$, or 5 drops of the resulting solution.

Therefore, as long as we keep the same ratio between the stock solution and the quantity of water with which it is to be diluted, we will always have a solution of which each drop contains gr. $\frac{1}{300}$, no matter how much of such a diluted solution we prepare.

Instead, then, of taking only **one drop** of the strychnine stock solution, and adding **two drops** of water, thus making up only three drops of a solution (of which each drop contains gr. $\frac{1}{300}$), we multiply the drop of the stock solution and the number of drops of water to be added, each by 5, or 10, or by any number which will make the total quantity of the resulting diluted solution more than the number of drops to administer. In this way, we make up a larger quantity of the same solution, each drop of which contains gr. $\frac{1}{300}$. In the example given above, if we multiply the number of drops of stock solution to use, and the number of drops of water to be added, each by 5, we make up 15 drops of a solution, each drop of which contains gr. $\frac{1}{300}$ of strychnine. 5 drops of this solution will contain gr. $\frac{1}{60}$ or gr. $\frac{5}{300}$ of strychnine.

When the dose to be prepared is larger than that contained in one minim of the stock solution:

Multiply the one drop of stock solution and the number of times it is to be diluted, each by any number which will make the total quantity of new diluted solution more than the number of minims to be given from it.

Example: To give gr. $\frac{1}{120}$ strychnine sulphate from a $\frac{1}{2}\%$ solution.

Each drop of the strychnine solution contains gr. $\frac{1}{200}$ of strychnine.

The least common denominator of 200 and 120 = 600.

According to the rule, $\frac{\Delta}{200} = \frac{\textcircled{3}}{600}$

$$\frac{1}{120} = \frac{\boxed{5}}{600}$$

Take one drop of the $\frac{1}{2}\%$ solution of strychnine, add (③ - Δ = 2) 2 drops of water, and take 5 drops of the resulting solution. Since the total quantity of the resulting solution is only 3 drops, we multiply the drop of stock solution, and the number of drops of water to be added, each by 3. We then take 3 drops of the $\frac{1}{2}\%$ solution of strychnine, and add to it 6 drops of water. Of this diluted solution we give the patient 5 drops.

Example: To give gr. $\frac{1}{75}$ of atropine sulphate from a solution of which m. v = gr. $\frac{1}{40}$.

Since m. v = gr. $\frac{1}{40}$, m. i = $\frac{1}{5}$ of $\frac{1}{40}$ = gr. $\frac{1}{200}$

Each minim of the stock solution contains gr. $\frac{1}{200}$ of atropine.

The least common denominator of 200 and 75 = 600

According to the rule, $\frac{\textcircled{1}}{200} = \frac{\textcircled{3}}{600}$

$$\frac{1}{75} = \frac{\boxed{8}}{600}$$

Take one drop of the atropine solution (stock) and add $\textcircled{3} - \textcircled{1} = 2$ drops of water. Take $\boxed{8}$ drops of the resulting solution. Since the total amount of the resulting solution is less than 8 drops, we multiply the drop of the stock solution, and the number of drops of water to be added, each by 4 (to make up a sufficiently large quantity). We then take 4 drops of the atropine solution, to which we add 8 drops of water. Of this diluted solution we take $\boxed{8}$ drops, add enough sterile water to fill up a hypodermic syringe and give to the patient.

CALCULATION OF DOSES FOR CHILDREN

To determine the dose of a drug to be administered to a child, we fill in the known quantities in the following formula, and then calculate it. The result is the fraction of the adult dose to administer.

Young's Rule: Age of child, divided by (age + 12) = the fraction of the adult dose, or,

$$\frac{\text{age}}{\text{age} + 12} \text{ of adult dose.}$$

For potent drugs, a slightly smaller quantity should be administered, and for some drugs a slightly larger dose should be administered.

Example: How much aspirin should be given to a child 3 years old? (Adult dose of aspirin = grs. v.)

$$\begin{aligned} \text{Age of child} &= 3 \\ \text{then, } \frac{3}{3 + 12} &= \frac{3}{15} = \frac{1}{5} \end{aligned}$$

We therefore give the child $\frac{1}{5}$ of grs. v or gr. i of aspirin.

SUMMARY OF CALCULATION OF DOSES

In preparing doses of potent drugs for hypodermic or internal use, the calculation of the problems will be facilitated by handling them in the following systematic manner:

Before solving each problem the nurse should determine:

1. Whether the dose is to be calculated from a tablet.
2. Whether the dose is to be calculated from a stock solution.

If the dose is to be calculated from a tablet the problem should be solved according to Rule 1, page 91.

If the dose is to be calculated from a stock solution, **the division method** may be used for the following problems:

- (a) Large doses from stock solutions of more than 1%.
- (b) Fractional doses from solutions of which a definite number of minims contain a definite dose.

The least common denominator method may be used for the following problems:

- (a) For all doses to be calculated from all relatively weak solutions such as 1% solutions or less.
- (b) For calculating fractional doses from solutions of which a definite number of minims contain a definite dose.

It should be remembered, however, that all problems from stock solutions may be solved by either method.

The calculation of doses will lose its terrors if the nurse remembers the rules to be applied in each particular case and the reasons underlying them. It must be emphasized, however, that one can become expert only by constant practice in solving many and varied problems.

TABLE OF USUAL STRENGTHS OF COMMONLY USED SOLUTIONS FOR INTERNAL USE

Name of Solution	Percentage of Solution	Quantity to Ounce
Ammonium Bromide.....	25%	℥ii
Ammonium Iodide.....	50%	℥iv
Aromatic Spirits of Ammonia....	4%	grs. xx
Arsenious Acid Solution.....	1%	grs. v
Caffeine Sodium Benzoate.....	25%	℥ii
Camphor Oil.....	20%	℥i $\frac{2}{3}$
Camphor Spirits.....	10%	grs. l
Camphor Water.....	0.8%	gr. iv
Dilute Acetic Acid.....	6%	m. xxx
Dilute Hydrochloric Acid.....	10%	m. l
Dilute Hydrocyanic Acid.....	2%	m. x
Dilute Nitric Acid.....	10%	m. l
Dilute Nitrohydrochloric Acid...	20%	℥i $\frac{2}{3}$
Dilute Sulphuric Acid.....	10%	m. l
Diuretin Solution (Theobromine Sodium Salicylate).....	25%	℥ii
Epinephrine Chloride (Adrenalin Chloride).....	0.01% (1-1000)	gr. $\frac{1}{2}$
Fowler's Solution of Arsenic (Liquor Potassii Arsenitis).....	1%	grs. v
Homatropine Hydrobromide.....	2%	grs. x
Mercuric Salicylate.....	10%	grs. l
Morphine Sulphate (Magendie's Solution).....	3%	grs. xv
Nitroglycerin solution.....	1%	grs. v
Paregoric (Tinct. Opii. Camphorata).....	0.4%	grs. ii
Potassium Iodide Solution (Saturated).....	100%	℥i
Potassium Iodide Solution.....	50%	℥ $\frac{1}{2}$
Sodium Bromide.....	50%	℥iv
Sodium Iodide Solution.....	50%	℥ $\frac{1}{2}$
Spirits of Chloroform.....	10%	m. l
Spirits of Ether.....	30%	℥ii $\frac{1}{2}$
Spirits of Ether (Compound)....	30%	℥ii $\frac{1}{2}$
Strontium Bromide.....	50%	℥iv

PROBLEMS

Doses from Tablets

How would you calculate and prepare the following doses:

1. Strychnine sulphate gr. $\frac{1}{50}$ from tablets of gr. $\frac{1}{30}$.
2. Eserine salicylate gr. $\frac{1}{30}$ from tablets of gr. $\frac{1}{40}$.
3. Atropine sulphate gr. $\frac{1}{50}$ from tablets of gr. $\frac{1}{100}$.
4. Atropine sulphate gr. $\frac{1}{120}$ from tablets of gr. $\frac{1}{100}$.
5. Atropine sulphate gr. $\frac{1}{60}$ from tablets of gr. $\frac{1}{100}$.
6. Heroin hydrochloride gr. $\frac{1}{8}$ from tablets of gr. $\frac{1}{3}$.
7. Strychnine sulphate gr. $\frac{1}{20}$ from tablets of gr. $\frac{1}{60}$.
8. Pilocarpine hydrochloride gr. $\frac{1}{8}$ from tablets of gr. $\frac{1}{8}$.
9. How many doses of strychnine sulphate gr. $\frac{1}{400}$ can you prepare from a tablet of gr. $\frac{1}{60}$, and how would you give this dose accurately each time?
10. How many doses of atropine sulphate gr. $\frac{1}{250}$ can you prepare from two tablets of gr. $\frac{1}{120}$, and how would you give an accurate dose each time?

Doses from Stock Solutions

How would you calculate the required dose from the stock solution in each of the following problems:

1. Caffeine Sodium Benzoate grs. vi from a 25% solution.
2. Camphor grs. v from a camphor liniment?
3. Sodium bromide grs. xv from a 25% solution.
4. Potassium iodide grs. xx from a saturated solution, and from a 50% solution.
5. Morphine sulphate gr. $\frac{1}{4}$ from a 1 : 30 solution.
6. Strychnine sulphate gr. $\frac{1}{30}$, gr. $\frac{1}{15}$, gr. $\frac{1}{60}$, gr. $\frac{1}{150}$, gr. $\frac{1}{200}$, gr. $\frac{1}{175}$, from a 1% solution.
7. Eserine salicylate gr. $\frac{1}{60}$, gr. $\frac{1}{40}$ from a $\frac{1}{2}$ % solution.
8. Strychnine sulphate gr. $\frac{1}{30}$, gr. $\frac{1}{50}$, gr. $\frac{1}{80}$, from a solution of which m. x contain gr. $\frac{1}{80}$.
9. Atropine sulphate gr. $\frac{1}{120}$, gr. $\frac{1}{250}$, from a $\frac{1}{2}$ % solution.
10. Morphine sulphate gr. $\frac{1}{4}$, gr. $\frac{1}{8}$, gr. $\frac{1}{10}$, gr. $\frac{1}{20}$ from Magendie's solution.
11. Atropine sulphate gr. $\frac{1}{60}$, gr. $\frac{1}{120}$, gr. $\frac{1}{200}$ from a solution of which m. v contain gr. $\frac{1}{30}$.
12. Atropine sulphate gr. $\frac{1}{120}$ from a solution of which m. x contain gr. $\frac{1}{150}$.
13. Eserine sulphate gr. $\frac{1}{60}$, gr. $\frac{1}{40}$, gr. $\frac{1}{75}$ from a $\frac{1}{4}$ % solution.
14. Strychnine sulphate gr. $\frac{1}{30}$, gr. $\frac{1}{60}$, gr. $\frac{1}{120}$, gr. $\frac{1}{150}$ from a 1 : 300 solution.

15. Nitroglycerin gr. $\frac{1}{150}$, gr. $\frac{1}{100}$, gr. $\frac{1}{75}$, gr. $\frac{1}{50}$ from a 1% solution.

Doses for Children

In each of the following examples, how much of the adult dose would you give:

- (1) Caffeine Citrate to a 4 year old child (adult dose is gr. i).
- (2) Morphine Sulphate to a 6 year old child (adult dose is gr. $\frac{1}{4}$).
- (3) Tincture of Digitalis to a 10 year old child (adult dose is m. x).
- (4) Atropine Sulphate to a 2 year old child (adult dose is gr. $\frac{1}{60} - \frac{1}{120}$).
- (5) Compound Licorice Powder to a 6 year old child (adult dose is $\mathfrak{z}$ i).

Miscellaneous

In each of the following problems indicate the methods to be used:

1. How would you give Caffeine Sodium Benzoate gr. ii from a 40% solution?
2. How would you give Atropine sulphate gr. $\frac{1}{80}$ from a $\frac{1}{2}\%$ solution?
3. Eserine salicylate gr. $\frac{1}{40}$ from a tablet of gr. $\frac{1}{60}$.
4. Strychnine sulphate gr. $\frac{1}{20}$ from a solution of which m. v contain gr. $\frac{1}{15}$.
5. Codeine sulphate 0.008 Gm. from a 1:50 solution.

CHAPTER VII

THE ADMINISTRATION OF MEDICINES

The administration of medicines is perhaps the most important branch of *Materia Medica* for the nurse. The effect of drugs may frequently depend upon the method of administration, the care with which they have been kept and the accuracy with which the doses are prepared.

The nurse should thoroughly familiarize herself with the physical and chemical properties of the medicines she is using either in the ward or when on private duty. She should develop habits of precision in preparing doses to such an extent that they should become her second nature.

CARE OF MEDICINES

1. All medicines should be kept in a special medicine chest.
2. It is customary to assign the care of the medicine closet to one nurse. The closet should always be kept locked and the key held by the nurse in charge, who should see that every commonly used substance is always in stock.

4. All bottles, boxes, etc., should be appropriately marked with labels which are not apt to fall off. The remedies should be arranged in the closet alphabetically in systematic order. The following order is suggested:

(a) Substances used externally should be kept together; solids and liquids in separate compartments.

(b) Substances for internal use should be grouped together; solids and liquids in separate compartments.

(c) Stimulants and all potent remedies such as morphine, etc., should be kept in a compartment by themselves, adjacent to the hypodermic tray, which should always be ready for use.

(d) All poisons should be labeled "Poison." They should be kept in distinctive bottles, such as blue rough bottles, and kept together in a separate compartment.

(e) Oils should be kept in a cool place, since they readily decompose.

5. The nurse in charge of the medicine closet should examine the contents of the closet daily. She should order whatever is

needed in small quantities and examine the character of all the medicines.

6. A change in color, consistency or odor of any substance should be reported to the physician or pharmacist and if this has interfered with its efficiency, a fresh supply should be obtained.

7. Every bottle of medicine should be corked and immediately replaced after use.

CARE OF APPARATUS

1. All apparatus should be kept together.
2. Weights should be kept clean by dusting, not by polishing.
3. Balances should always be kept covered.
4. Test the balance before use.
5. For measuring fluids glass utensils should be used.

ACCURACY

While preparing medicines the nurse should concentrate her entire attention upon the work. She should not be disturbed by other duties.

1. When calculating doses be sure your answer is correct; verify it if in doubt.

2. Familiarize yourself with the smallest and largest doses of the remedies you are giving. If you think the maximum dose has been exceeded always verify it.

3. Always look **three** times at the label of every bottle or box before using any of its contents: when taking it from the closet, when removing the contents, and when returning the bottle or box to the medicine closet.

4. Never use medicines from an unmarked bottle, or when you are in doubt as to the nature of the contents.

5. When pouring fluids, hold the bottle with the label pointing upwards so as to avoid soiling it.

6. Measure the quantities as ordered; do not give a teaspoonful when a dram is ordered, and vice versa. Measure the quantities with graduated measuring glasses or marked glass spoons. Do not use household utensils unless the others are not available.

7. When measuring fluids hold the graduate so that the surface of the fluid, which is usually curved, is on a level with the eye. The quantity is read when the lowest part of this curve is on a line with the mark of the desired quantity, thus:



8. Never pour a medicine back into the bottle.

9. A medicine which forms a precipitate with another substance should always be given alone. Such medicines are said to be **incompatible**.

10. All the medicines being administered in the ward should be listed. There are several methods of listing. The most common one is to have a distinctive color for the various times of administration. These are placed on a board near the medicine chest, together with the names of the patients.

11. All medicines should be appropriately marked as soon as prepared.

12. Give all medicines at the times ordered; b. i. d. medicines should be given at 8 A. M. and 6 P. M., t. i. d. medicines should be given at 8 A. M., 12 M. and 6 P. M.

13. Always stand at the patient's bedside until the medicine is taken.

14. Never allow one patient to administer medicines to another.

THE PRINCIPLES OF ADMINISTRATION

Drugs are given to cause local or general effects, or both. **Local effects** result from a direct application of a substance to a tissue or organ, thus changing its function.

General or systemic effects result when a drug enters the blood stream and affects tissues or organs remote from the site of application.

It is frequently essential for the nurse to know the effect that is desired, as the method of administration may vary accordingly.

ADMINISTRATION FOR LOCAL EFFECTS

For a local effect it is merely desired to bring the remedy in contact with a diseased tissue or organ. As a rule, the more prolonged the contact the greater is the effect. Local remedies are usually applied in the following forms:

Solutions	} Applied only on skin
Liniments	
Ointments	
Oleates	
Cerates	
Poultices	
Plasters	
Powders	
Lozenges	
Bougies	
Suppositories	

Administration of Solutions

Substances are usually applied locally in solutions for their antiseptic effect: to check the growth of bacteria. The longer the solution is in contact with the wound the greater is the antiseptic action. The solution must be changed frequently, however, since the effect soon wears off.

The best antiseptic action is obtained by keeping the wound in a continuous bath of the solution, which is not always possible, however.

Wet Dressings

The most common way in which antiseptics are applied is by means of gauze which has been soaked in the required solution. The dressings are kept moist by frequent changing or by covering with rubber tissue. Frequent changing is the better method since it not only keeps the dressings moist but drains the secretions and keeps the wound dry.

Administration of Douches

Solutions used as douches are given for their antiseptic or constricting (astringent) effect on the mucous membrane of the vagina and cervix and to remove accumulated secretions. Douches are also given to check bleeding from the uterus or cervix, and to lessen pain produced by their contraction. Contact with the diseased tissues is essential for the effect. It is especially important that every part of the vaginal fornix be irrigated to remove the secretions which usually accumulate in these regions.

Method: The patient should lie flat on the back with the thighs and legs flexed and a pillow underneath the buttock. The sterilized nozzle is then inserted far back into the vaginal fornix. The fluid is allowed to run from the bag held about two feet above the patient and the nozzle gently moved about to distribute the fluid over the entire mucous membrane.

For an antiseptic or an astringent effect, or for drainage, the temperature of the fluid should be that of the body, about 100° F. To check bleeding or to lessen pain, solutions should be as hot as the patient can stand.

Administration of Mouth Washes and Gargles

Mouth washes and gargles are used for diseased conditions of the mouth and throat: to cause an antiseptic or a constricting (astringent) effect. In administering mouth washes and gargles

it is essential to bring the drug in contact with every part of the lining membrane of the mouth and throat. This is usually accomplished by keeping the fluid in the mouth and moving it about by means of a current of expired air.

Fluids applied in this manner do not affect the tonsils or pharynx to any extent, since they do not reach back far enough. Local applications to these tissues are best applied by sprays or irrigations.

Irrigation is a very good method for applying medicines to the throat. It is usually done by means of a glass nozzle attached to an irrigating bag, with the patient lying down, the head on the side and the mouth and chin slightly tilted forward.

Administration of Liniments

Liniments are usually applied for their soothing effect. They should be applied on a piece of flannel or lint which keeps the skin warm, prevents evaporation of the liniment and thereby helps the action. Many liniments are applied by vigorous rubbing. Whatever effect is then produced is due principally to the vigorous massage and very little, if any, to the liniment itself.

Administration of Ointments

Ointments may be applied for a local or a general effect. They are the best means of applying remedies for a prolonged local effect. The fat in which the drug is contained dissolves readily but does not evaporate, thus prolonging the effect of the drug on the site of application.

The ointment should be spread on a piece of flannel or lint and applied to the site ordered; it should be changed frequently; about every day. Ointments should be avoided on discharging wounds as they prevent free drainage of the secretions. For a general effect they are applied by rubbing. See page 115.

Oleates and Cerates are administered like ointments.

Administration of Poultices and Plasters

Poultices and plasters are usually applied to produce the following effects:

1. To relieve pain.
2. To dilate the blood vessels of the skin (rubefacient action). Blood is thus brought to the surface from the deeper tissues or organs, relieving congestion and inflammation of many organs. Poultices or plasters cause other reflex effects. (See Counter-irritants.)

3. To produce blisters. This is merely an exaggeration of the rubefacient effect as the result of a prolonged application or of a stronger preparation.

Poultices are usually diluted with flour until the desired strength is obtained. They are moistened and wrapped in a piece of gauze or lint and applied to the site ordered.

Plasters should be moistened in lukewarm water before being applied.

Poultices or plasters should remain on the skin for ten to twenty minutes to induce a rubefacient action and longer for the formation of a blister. The nurse may vary the duration of the application, however, so as to obtain the desired effect. Some plasters, such as mercury plaster, may be kept on the skin for days.

Other Forms of Local Administration

Powders are usually dusted over the surface of a wound or ulcer.

Lozenges are kept in the mouth; they are dissolved by the saliva, and the medicinal substances which they contain then affect the mucous membrane of the mouth.

Bougies are long thin medicated tubes, made with wax. They dissolve in mucous membrane lined cavities, and then produce either local or general effects.

Suppositories are cone-shaped preparations of drugs made with cocoa butter, and are applied in the same manner as bougies.

ADMINISTRATION FOR GENERAL OR SYSTEMIC EFFECTS

When a remedy is given for a general or systemic effect, to act upon organs and tissues remote from the site of application, the drug must enter the blood stream. Thus it will reach, through the circulating blood, the organ or tissue for which it has a selective action and induce the desired effects. By the chemical combination of the drug with some of the constituents of the cells of these organs, certain desired changes in the activity of the organs are brought about. For example, when a dose of morphine sulphate is given to a patient to relieve pain, the dose is dissolved in the gastric juice and passes through the mucous membrane of the stomach into the blood stream. Here it is carried by the moving stream until it reaches the cells of the gray matter which are selectively affected by the morphine.

It then affects the areas in the brain which appreciate pain. A chemical combination of the morphine and some of these cells probably occurs, thus lessening their function and pain is therefore not appreciated.

The simplest way in which general effects are produced is by directly injecting the drug into one of the veins. The following are the methods used for administration for general effects arranged in the order of the rapidity with which the effects are produced:

1. Intravenous method
2. Intramuscular method
3. Hypodermic method
4. By mouth
5. By rectum
6. By the skin

Intravenous Administration

Intravenous Injection

Intravenous injections are usually given by the physician. The median basilic or median cephalic vein at the front of the elbow is the most suitable vein for injecting drugs. A rubber or gauze bandage is wound tightly around the middle of the arm and the hand is gripped firmly while the forearm is extended. The vein is thus made to stand out prominently. The surface of the skin over the vein is then sterilized with green soap, 50% alcohol and a 1:2000 bichloride of mercury, or the site may be painted with tincture of iodine.

A sterilized hypodermic syringe is now filled with a sterile solution of the drug to be injected and the air expelled from the syringe. The needle is then inserted into the vein, pointing upward, and a few drops of blood slightly withdrawn from the vein. When blood enters the syringe you are sure the needle is in the vein.

The bandage of the arm may now be loosened and the solution of the drug should be injected very **slowly**. Slow injection is very important, as serious, even fatal, results have occurred from too rapid injection.

Intravenous Infusion

Intravenous infusions are usually given by the physician. The arm is prepared as for an intravenous injection. The fluid is made up in a special sterile glass container, which is placed on a

stand above the level of the patient. To this bottle is attached a rubber tube and a needle, or cannula. The needle is inserted into the vein, pointing it toward the heart, and the fluid is then allowed to flow. If a cannula is used, the vein must be exposed, opened, and the cannula inserted into the open vein in a direction toward the heart. The effects of an injection appear almost immediately.

Intramuscular Administration

The site for an intramuscular injection is usually one of the buttocks, or the front of one of the thighs. The skin over the site of injection is sterilized in the usual manner. A sterilized hypodermic syringe is filled with a well diluted solution of the drug to be injected and fitted with a large firm needle. The needle is then inserted perpendicularly into the muscles. The syringe may now be withdrawn or slightly aspirated. If blood is obtained a new site must be chosen, as the needle has probably been stuck into a vein. If no blood is obtained the solution may be injected, but very slowly; and the area of injection should then be thoroughly massaged and covered with a little collodion or some other dressing.

Hypodermic Administration

The best sites for hypodermic injection are the front of the thighs, or the outer part of the arms and forearms. The skin at the site of injection should be sterilized by rubbing with 50% alcohol or by painting with tincture of iodine. The sterilized syringe is now filled with a well diluted solution of the drug to be given and held in the right hand with the neck of the syringe resting between the index and middle finger with the thumb on the piston. The skin at the site of injection is then taken between the thumb and index finger of the left hand and the needle inserted under the skin at an angle of about 45 degrees. The place of injection should then be thoroughly massaged.

In giving a hypodermic injection it is very essential to inject the drug under the skin, not into the skin. When the drug has been injected into the skin the area of injection looks like goose skin and the needle should be withdrawn and a new place chosen. This should be sterilized and the injection repeated.

The effects of a hypodermic injection usually appear in about ten minutes to a half hour, depending upon the patient's circulation; the better the circulation the more rapid are the effects.

It may also be noted that the more the drug is diluted the

better and the more rapid are the effects following a hypodermic injection.

ADMINISTRATION BY MOUTH

The most common way in which medicines are given is to let the patient drink a fluid which contains the medicine, or to swallow it in the form of a pill, capsule or tablet.

In administering any remedy the nurse should consider the following points:

1. Absorption
2. Desired effect
3. Taste
4. Time of administration

Absorption

Absorption is the process whereby a drug enters the blood stream by passing through the lining membrane of the stomach or intestines or from the tissues.

Except in the case of acids, alkalies, salts, and a few other substances, our knowledge of the absorption of remedies is as yet very meager. Most drugs are absorbed in the stomach and intestines but in their own particular way. Some drugs are readily absorbed while others are not absorbed at all.

How to Aid Absorption

The following facts will enable the nurse to administer most drugs so as to increase their absorption:

1. A substance which is capable of producing a general effect must be absorbed into the blood stream.

2. Before any substance can be absorbed it must be dissolved in a fluid, either before administration or in the fluid of the stomach or intestines.

3. Absorption takes place more rapidly with or from some fluids than others.

The following is a list of fluids in which medicines are commonly given, arranged according to the rapidity with which medicinal substances are absorbed with or from them:

- Water
- Weak acids
- Alcoholic beverages
- Syrups
- Oils
- Colloids (albuminous solutions)

(4) A substance is absorbed most readily when it is dissolved in water. With the possible exception of lemonade and grape juice, weak acids are seldom used as mediums in which to administer medicines.

(5) Alcohol and oils will aid the absorption of whatever substances may be dissolved in them, because they themselves are easily absorbed.

(6) The larger the quantity of fluid, the more readily will its dissolved substance be absorbed, with or from the fluid.

→ (7) More absorption takes place after meals than before meals, because the stomach and intestines are supplied with more blood at that time and the capillaries and lymphatics are widened.

(8) Substances which combine with foods cannot be absorbed, until the chemical combination is broken down by the digestion of the food.

Desired Effect

In administering medicines by mouth it is often essential for the nurse to know whether a local or a general effect is desired. For a general effect absorption should be aided and for a local effect it should be retarded.

Taste

Taste is a very important factor from the patient's standpoint. A patient may dislike a remedy because of its bitter, bland or unpleasant taste. The bitter taste is often necessary for the effect and should not be disguised. When the unpleasant taste is not necessary for the effect it may be lessened by giving the remedy in a large quantity of fluid or in syrup, wine or jam.

Oils such as castor oil should be given in the form of a cocktail or as an emulsion with lemon, orange, or grape juice. Very small quantities of an oil should be given on a lump of sugar or in melted butter.

The taste of powders may be disguised by placing the powder in a capsule, cachet or konseal or by wrapping it in a small disk of rice paper.

Unpleasant tasting fluids should be given cold, followed by a copious drink of water.

Time of Administration

The time to administer most remedies is not as important as patients frequently imagine. For certain effects, however, some periods of administration are preferable to others.

Remedies should be given **before meals** for the following effects:

1. To aid the appetite or to increase the secretion of digestive juices.
2. For a local effect on the stomach or intestines. When the substances are irritating they should be given in milk. The combination of the remedy with the protein of the food lessens the irritation.

Remedies should be given **after meals** for the following effects:

1. To neutralize digestive juices when these are present in excess.
2. To aid absorption and produce rapid effects.
3. To prevent an irritating effect in the stomach. The irritation is lessened by the combination of the remedy with the protein of the food.

Cathartics should be given **between meals** on an empty stomach. Those acting slowly should be given at night. Those acting quickly should be given in the morning.

Rules for Administration by Mouth

1. For a rapid general effect give the substance diluted in a large quantity of water immediately after meals, thus aiding absorption.
2. For a slow gradual general effect give substances in small quantities of syrup, milk or wine between meals, to retard absorption.
3. For a local effect on the stomach or intestines give the substance in acacia, mineral oil, or in milk, thus lessening absorption.
4. Taste and time as indicated above.

Protection of Mouth and Teeth

Remedies which are injurious to the teeth such as iron or acids should be given through a glass tube or straw.

Administration to Children

To children medicines should always be given in fluid form. Special care should be taken to thoroughly disguise substances having an unpleasant taste. Pills, tablets or capsules should not be given to children as they are apt to chew these preparations before swallowing them.

Administration to Unconscious or Insane Patients

Unconscious or insane patients who are unwilling to take medicines should be given substances only in fluid form. The medicine should be dropped on the back of the tongue with a small spoon. To insane patients it is frequently necessary to administer medicine through a narrow stomach tube passed through the nose.

ADMINISTRATION BY RECTUM

Remedies are given by rectum for the following effects:

1. To move the bowels.
2. To medicate diseased condition of the rectum, sigmoid or colon.
3. For absorption, to cause general effects.

Enema: For a cathartic effect the object of injecting a fluid into the rectum is merely to distend the bowels. This starts peristalsis and causes movements of the bowels. Drugs are usually given for this effect by means of an enema. When it is desired to inject fluid into the sigmoid or descending colon the patient should be placed in the knee elbow position.

Irrigation: To affect the mucous membrane of the rectum or descending colon or to remove gas or fluid, irrigations are used. The method consists of injecting fluid into the rectum and siphoning it back. An ordinary enema can, with a tube and tip, is used. The lubricated tip is inserted into the rectum, the fluid is allowed to run in and is then siphoned back by alternately elevating and lowering the can. Every time the can is lowered below the level of the patient the fluid should return from the rectum.

An excellent method of irrigating is by means of Kemp's irrigating tube, which consists of an inflow and outflow tube in one. The inflow tube is connected with the can by means of a rubber tube. When the fluid is allowed to run into the rectum it returns through the outflow tube.

For absorption: Remedies are frequently given by rectum for absorption, in cases where it may not be possible or where it is harmful to administer them by mouth. They may be given in the form of suppositories which consist of cocoa butter impregnated with the drug. These are inserted into the rectum, the cocoa butter dissolves, is absorbed and carries the drug with it into the blood stream.

Substances are absorbed more readily from the rectum, however, when given by the **Rectoclysis** or **Murphy** method. The method is the same as an irrigation, but a return flow is not desired. The essential feature of this method is to allow the fluid to run in slowly, drop by drop, so that it is absorbed and does not distend the intestine. The drug to be administered should be dissolved in a large quantity of water (about a pint to a quart). Normal salt solution should not be used as a solvent as it is not absorbed as readily as water. Many remedies such as the salicylates are occasionally given by this method.

Although substances are not absorbed as readily from the rectum as from the small intestine, the chemical changes that may occur with the food or in the passage through the liver may thus be avoided, and the substances then enter the blood in a pure form.

ADMINISTRATION BY INHALATION

Many substances are frequently given by inhalation. The drug is usually dissolved in water which is kept constantly boiling so that steam is formed. This may be done in a specially constructed apparatus (croup kettle), or in an ordinary dish. The patient sits under an improvised tent and inhales the medicated steam.

Drugs such as stramonium are frequently given by inhalation by merely burning the leaves in a saucer or by having the patient smoke cigarettes made from such leaves.

ADMINISTRATION BY INUNCTION

Drugs are frequently given for absorption by rubbing on the skin. They are usually applied in the form of an ointment from which the drug is absorbed and produces its effects. The ointment must be rubbed over a large area of skin to get the greatest amount of absorption, and since the pores of the skin frequently get clogged up with it after constant use, a different region of the body should be used every day. Six successive daily rubbings on various parts of the body are called a "course." The course is usually given in the following order:

Each thigh, each arm, the chest, and finally the back. On the seventh day the patient should be given a bath to eliminate the drug and then the course is begun again.

When administering potent remedies by means of rubbings, the nurse should protect her hands by old kid gloves or by

rubbing the ointment with a piece of chamois. Otherwise she may absorb it herself and get poisonous effects. The efficacy of the method depends largely on the vigor with which the ointment is rubbed and the extent of the surface used.

ADMINISTRATION BY VAPOR

Some substances, such as mercury, are frequently given by means of vapor formed by burning some of the preparations. The patient sits in a small closed cabinet over the fumes formed by burning the drug in a saucer, the head protruding from the top. The vapor generated in the cabinet is absorbed by the skin and induces the desired effects.

ADMINISTRATION OF VARIOUS REMEDIES

Administration of Acids

The dilute acids are usually given to replace acid in the stomach when its secretion is diminished. They may injure the enamel of the teeth, so that they must be given through a glass tube or straw. In giving acids an attempt should be made to imitate the normal secretion of acid in the stomach. This is best accomplished by dissolving the dose in a large quantity of water and allowing the patient to sip it slowly through a glass tube or straw.

Administration of Inorganic Salts

Inorganic salts are of two kinds: alkaline* and metallic. The alkaline salts that are not readily absorbed are used to neutralize excessive acid in the stomach and as cathartics, while those that are readily absorbed are used as diuretics. Of the metallic salts, mercury, iron and arsenic are the ones commonly used for absorption. The others are occasionally used, but only for their local effects.

Saline Cathartics: Most of the salts used as cathartics are not readily absorbed, even when given in very dilute solutions. They usually act merely by withdrawing fluid into the intestines from the tissues and blood. The more concentrated the salt solution, that is, the more its percentage of salt exceeds that of the blood, the more is the quantity of fluid withdrawn. When enough fluid passes into the intestines to distend them, bowel

*For administration of alkalies and alkaline salts, see page 147.

movements result. Practically, with concentrated solutions this takes quite some time, but with dilute solutions it occurs more rapidly. It is therefore better to give saline cathartics in dilute solutions; that is, in one or two tumblerfuls of water, before breakfast, when the stomach is empty, to avoid chemical combinations with the food.

To remove fluids from the tissues to relieve oedema, salts should be given concentrated, very slightly diluted, since they will then withdraw more fluid.

Saline Diuretics: The salts given as diuretics are usually readily absorbed. Only part of the salt, however, is absorbed, but a sufficient quantity to act upon the kidneys. Saline diuretics should be given in a large quantity of water, in one or two tumblerfuls, between meals.

Metallic Salts: The metallic salts combine readily with the proteins of the cells of the mucous membrane of the stomach and intestines with which they come in contact. If this chemical combination takes place to any degree, the cells become injured. This irritation is responsible for the symptoms of poisoning, such as vomiting, diarrhoea, etc., that follow the use of many metals. When the albuminate formed by the combination of the metal and the cells dissolves readily in the excess of fluid protein with which the body cells are constantly bathed, the metal is absorbed and general or systemic symptoms result. This is the case with substances such as mercury, iron and arsenic, which are usually given for their general effects. Absorption of these salts may be increased then, by giving them in a large quantity of a fluid, such as milk. In such a fluid the metal readily combines with the proteins, the irritation is avoided, and at the same time absorption is aided.

For a local effect, the metallic salts should be given in smaller quantities of a similar fluid, but between meals, since there is not as much absorption from smaller quantities of fluid, and at this time. The salts commonly given for local effects are the preparations of bismuth.

The organic preparations of the metals are already combined with an albumin. The metals that are absorbable are therefore more readily absorbed, while those that are not usually absorbed are less irritating.

The Iodides and Nitrites: The iodides and nitrites separate very readily into their constituent elements and combine rapidly with the albumins of the cells of the stomach and

intestines. This accounts for the pain in the region of the stomach which occasionally follows the use of such preparations as potassium iodide. To lessen the irritation, the iodides should be given in a glass of milk after meals. A little wine, sarsaparilla or cinnamon water may be added to disguise the salty taste.

Administration of Alkaloids and Their Salts

Most of the active principles are alkaloids.

The alkaloids themselves do not dissolve easily and are therefore not absorbed. They are usually given, however, in the form of salts, which they readily form with acids. Some of the salts, such as hydrochlorides and sulphates, are absorbed more readily than others. These salts are therefore preferable for rapid effects.

The alkaloids should always be given in a large quantity of water (about a wineglassful to half a tumblerful), so as to increase the absorption. They have a bitter taste, however, which may be lessened by adding a little syrup, raspberry juice or cinnamon water.

It has long been known empirically that very dilute solutions of the salts of the alkaloids are the most efficient preparations. For example, the efficiency of Magendie's solution of morphine sulphate is due to the fact that it is a dilute 1:30 solution in water, which is rapidly absorbed.

Administration of Glucosides

Glucosides are the active principles of many drugs.

Most of the glucosides are relatively insoluble substances, and are therefore not readily absorbed. They are slowly absorbed, however, from many of the galenical preparations of their crude drugs, such as tinctures, infusions, fluid extracts, etc. We shall consider the administration of these substances together with the other galenical preparations. There are, however, a number of new preparations of glucosides which have been made soluble, such as those of digitalis. Of these, perhaps the most commonly used preparations are digalen, strophanthin, and ouabain. These are usually given for rapid effects and should be administered in about a wineglassful of water flavored with just a little syrup.

Administration of Galenical or Physical Preparations

The galenical preparations are made from the crude drug by purely physical means. They are the extracts, tinctures, infusions, fluid extracts, etc. These preparations contain the

crude drug in a more or less diluted form. The fluid preparations are more active than the solid ones.

The galenical preparations should always be given well diluted in a wineglassful to a tumblerful of water. The preparations which have an unpleasant taste may be given in diluted syrup, raspberry juice or wine.

The effects of the physical preparations appear very slowly because their active principles are but slowly absorbed from the preparations.

Administration of Hypnotics

Most of the drugs used as hypnotics are substances of a comparatively complex chemical structure and are slowly absorbed. They are usually given for effects that are to last for several hours. They should be administered in a tumblerful of warm milk about a half to two hours before the usual bedtime, the actual time depending on the rapidity with which the particular drug is absorbed.

The slow absorption of a substance such as sulphonal may be somewhat increased by giving it in milk well diluted with water.

The nurse should avoid giving chloral in small quantities of water, which tend to cause irritation of the stomach and rapid absorption.

When giving hypnotics by the rectum they should be dissolved in about two ounces of boiled starch and injected into the rectum through a catheter, by means of a syringe.

Administration of Coal Tar and Newer Synthetic Drugs

This group includes such substances as phenacetine, acetanilid, antipyrine, pyramidon, and many of their derivatives. Salicylic acid and its newer compounds such as aspirin are given in the same manner.

These substances should be given between meals in about a wineglassful of wine or milk. Wine is perhaps preferable because the alcohol will tend to overcome the weakening action on the heart of many of these substances. The coal-tar drugs should be given in small quantities of fluid for slow absorption. This prevents the sudden formation of large quantities of the substances which are responsible for their poisonous effects.

Administration of Oils

Oils are given for nourishment or as laxatives. They are broken up in the intestines into fine globules by the bile and

pancreatic juice, and are then decomposed into their constituent fatty acids. These may be combined again and stored up in the body as fatty tissue. Many of the fatty acids thus formed in the intestines are substances which have a decided cathartic effect. The oils given as cathartics usually have a very unpleasant taste which must be disguised. This is usually done by giving the oil with raspberry juice, wine, soda water, lemon juice or whiskey. These fluids prevent the contact of the oil with the taste buds in the mouth and thus impart their own taste to the tongue rather than that of the oil. It is not essential that oils used as cathartics should be fresh. Old rancid oil is often better, as it has already been changed to fatty acids which are responsible for the effect.

Administration of Mineral Oil

Liquid petrolatum, mineral oil, or liquid paraffin is usually given merely to prevent absorption of water; thus increasing the bulk of the faeces, and lubricating the intestinal tract; which results in movements of the bowels. They should be given undiluted about two hours after meals, perhaps slightly flavored with a little peppermint, raspberry juice or cinnamon water.

METHODS FOR INTERNAL ADMINISTRATION OF COMMON REMEDIES

Based on Physico-chemical Laws

Drug	Time of Administration	Character and Quantity of Fluid	Method of Administration
<i>Acids:</i> Dilute hydrochloric Dilute sulphuric Dilute nitric, etc.	Before or with meals.	In tumblerful of water.	{ Sipped through a glass tube or straw.
<i>Alkalies:</i> Sodium bicarbonate Lime water Calcium salts, etc.	For effect in stomach <i>after meals</i> . For general effects <i>before or between meals</i> .	In half wineglassful of milk. In glass of water.	
<i>Inorganic Salts:</i> Sodium sulphate Sodium phosphate Potassium sulphate Potassium and sodium tartrate (Rochelle salt) Magnesium sulphate Carlsbad water Magnesium citrate Seidlitz powder..... Potassium bitartrate Potassium } Acetate Sodium } Potassium } Citrate Sodium } Iodides Nitroglycerin, nitrites, etc.	In the morning on an empty stomach After meals.....	To lessen oedema, in wineglassful of water. For cathartic or diuretic effect in glass (or more) of water. In glassful of milk, flavored with a little sarsaparilla, wine or cinnamon water.	{ Dissolve each <i>Seidlitz Powder</i> in $\frac{1}{3}$ to $\frac{1}{2}$ glass of water and mix the two together. { Iron preparations should be sipped through a glass tube or straw. { For X Ray pictures, in glass of milk or as porridge.
<i>Metallic Salts:</i> Mercury Iron Arsenic Silver Zinc, etc. } used as astringents Bismuth salts Barium	For absorption after meals..... For local effect between meals.	In glass of milk In small quantity of milk.	{ Iron preparations should be sipped through a glass tube or straw. { For X Ray pictures, in glass of milk or as porridge.
<i>Alkaloid Salts:</i> Morphine Atropine Strychnine, etc. } salts Quinine	After meals. As bitter, before meals. As bitter, before meals, undiluted.	In wineglassful of water slightly flavored. In wineglassful of sherry wine.	

Drug	Time of Administration	Character and Quantity of Fluid	Method of Administration
<i>Glucosides:</i> Digalen Strophantin Ouabain Digitalis Preparations	Between meals. . . .	In glass of water slightly flavored.	
<i>Galenicals:</i> Extracts Infusions Fluidextracts Tinctures, etc. Bitters	Before meals.	Well diluted in a large glass of water. Undiluted and unflavored.	
<i>Hypnotics:</i> Chloral Trional Luminal Veronal	15 min. before bed-time. $\frac{1}{2}$ to 2 hours before bed-time.	In glass of warm milk or in beer.	{ May be given per rectum in $\frac{3}{4}$ ii of boiled starch solution, injected with a glass syringe through a catheter.
Sulphonal Paraldehyde, etc.	2 to 3 hours before bed-time.	Milk should be well diluted with water.	
<i>Coal Tar and Synthetic Drugs:</i> Phenacetine Acetanilid Antipyrine Pyramidon Salicylates Aspirin, etc.	Between meals. . . .	In wineglass of wine or milk.	
<i>Oils:</i> Olive oil Cod liver oil Castor oil	1 or 2 hours after meals.	In wineglassful of brandy, wine or lemon juice "Cocktail method" or as emulsion. One or two drops dissolved in glycerin, olive oil, or butter, or on a piece of bread or sugar.	{ To unconscious or insane patients: Placed on back of tongue with a spoon.
Croton oil			
<i>Hydrocarbons:</i> Liquid Petrolatum (Mineral oil) Liquid vaseline Albolene		Add just a little peppermint, raspberry juice or cinnamon water to flavor.	

CHAPTER VIII

PRESCRIPTION READING

It is important for the nurse to be able to read prescriptions, as she is occasionally ordered to administer a medicine the ingredients of which are written in the form of a prescription.

Every prescription consists of four parts:

1. The Superscription
2. The Inscription
3. The Subscription
4. The Signature

1. The **superscription** consists of the date and the name of the patient, which are written at the top (occasionally the name of the patient is written at the lower right-hand corner), and the symbol *R*, which stands for the Latin word *Recipe*, meaning "take thou." It is also a symbol of Jupiter, the Greek god, and is a relic of the days when all prescriptions were begun with a prayer to him, invoking his divine aid in making the ingredients more efficacious.

2. The **inscription** consists of the names and the amounts of the ingredients used.

The names are written in Latin, usually in the genitive case; for example, Camphora (genitive, Camphorae).

The most important ingredient in the prescription is written first and is often called the **basis**.

This is followed by the next important ingredient, which is called the **adjuvant**.

The next substance on the prescription is usually the one which disguises the taste of the mixture, such as a syrup, and is often called the **corrigent** or **corrective**.

The last substance on the prescription is the one in which all the others are dissolved, and it is often called the **vehicle**, **excipient** or **menstruum**.

The quantities of the ingredients are written in the metric or apothecaries' system of weights and measures.

In the metric system, the units used are the Gram and milligram, or mil.

In the apothecaries' system, the units used are the dram, grain, minim, etc. They are written in the Arabic symbols, Roman numerals being used, however, for the numbers, unless the quantity is a fraction, in which case the Arabic numerals are used.

Example:

℥v	=	5 drams
grs. xx	=	20 grains
℥ix	=	9 scruples
℥i or ℥j	=	1 ounce
℥iii	=	3 pints
℥ss	=	$\frac{1}{2}$ dram
gr. $\frac{1}{100}$	=	$\frac{1}{100}$ grain

The abbreviation ss is for the Latin word semis, meaning half.

3. The **subscription** consists of the directions to the druggist for compounding the prescription. These are usually written in Latin.

Certain abbreviations are commonly used in the subscription. The following are most frequently used:

q. s.	=	quantum sufficiat (as much as may be necessary)
q. s. ad	=	quantum sufficiat ad (as much as may be necessary to)
M.	=	misce (mix)

F. fiat (singular) used when only one ingredient is written.

F. fiant (plural) when many ingredients are used.

F.	=	fiat	=	make
D.	=	dentur	=	give
Div.	=	divide	=	divide
caps.	=	capsulas	=	capsule
pil.	=	pilulas	=	pill
chart.	=	chartas	=	powder
tab.	=	tabellas	=	tablet
tab. trit.	=	tabellas tritirates	=	tablet triturates
troch.	=	trochiscos	=	lozenges
supposit.	=	suppositoria	=	suppositories
	=	tales	=	such
dos.	=	doses	=	doses
ad. scat.	=	ad scatulam	=	in the box
	=	pone in scat.	=	put in a box
	=	cochleare	=	spoon
	=	cochleare parvum	=	teaspoon

The following are the most common Latin verbs used in prescriptions:

adde	= add
bulli	= boil
cola or colator	= strain
filtra	= filter
solve	= dissolve
tere	= rub
tere bene	= rub well

The following are the most common adjectives used:

aequalis	= equal
aa. = partes aequales	= equal parts
bulliens	= boiled
fervens	= hot
saturatus	= saturated
magnus	= large
parvus	= small

The **signature** is usually written at the end of the prescription and consists of the directions to the patient. It always begins with the abbreviation S. meaning signa or mark (on the label).

The quantities to be administered are written in the metric or apothecaries' system; for example, a teaspoonful is written 4.0 or $\mathfrak{z}\text{i}$. A dessertspoonful is written 8.0 or $\mathfrak{z}\text{ii}$.

The following are the abbreviations used in the signature. It is important for the nurse to know their definitions, as they may be used in her orders:

<i>gutt.</i>	= gutta	= drop
A. M.		= morning
P. M.		= evening
o. d.	= omne die	= daily
o. m.	= omne mane	= every day
o. n.	= omne nocte	= every night
m. et n.	= mane et nocte	= day and night
t. i. d.	= ter in die	= 3 times a day
b. i. d.	= bis in die	= twice a day
q. i. d.	= quatuor in die	= four times a day (not to be given at night)
q. h.	= quaque hora	= every hour
q. 2 h.	= quaquae duae horae	= every 2 hours
q. 3 h.	= quaquae tres horae	= every 3 hours

When medicines are ordered to be given q. 2h. or q. 3h. etc., they must always be given at night also.

stat. = statim = at once, immediately

s. o. s. = si opus sit = if necessary

This refers to only one dose. More than one dose should not be given if a medicine is ordered s. o. s.

p. r. n. = pro re nata = when required
(as often as necessary)

When a drug is ordered p. r. n. the nurse may use her judgment in giving more than one dose.

a. c. = ante cibum = before meals

p. c. = post cibum = after meals

At the end of the prescription, the physician's name is signed.

EXAMPLES OF PRESCRIPTIONS OF FLUID MEDICINES

May 17, 1905

For Mr. John Jones

℞	
Magnesii Sulphatis	℥ii
Magnesii Carbonatis	
Spiritus Ammoniae Aromatici aa	℥i
Aquae q. s. ad	℥i
M. et Sig. ℥i t. i. d.	

Dr. Brown

In this prescription, the superscription is the ℞ and Mr. John Jones.

The inscription is the mixture of the ingredients, of which the magnesium sulphate is the most important, magnesium carbonate next in importance, while the water is the excipient or menstruum.

The directions to the pharmacist are simply to mix the ingredients together (misce); and the directions to the nurse are to administer one teaspoonful of it three times a day (t. i. d.).

May 5, 1904

For Mr. Bates

℞	
Bismuthi Subnitratis	15.0
Mucilaginis Acaciae	10.0
Syrupus Simplicis	5.0
Aquae Cinnamomi q. s. ad.	60.0
Misce et Sig. ℥i q. i. d.	

Dr. Jameston

This prescription reads:

For Mr. Bates.—

Take thou, of bismuth subnitrate 15 Grams, of mucilage of acacia 10 Grams. of simple syrup, 5 Grams, and add enough cinnamon water to

make up 60 Grams. Mix the ingredients together and give the patient one teaspoonful of the mixture four times a day.

This is a very good method of prescription writing.

If the mixture is made up in a two-ounce bottle, the number of grains of each ingredient, in every teaspoonful, is the same as the number of Grams of each ingredient in the entire mixture; since there are 60 Grains in each dram or teaspoonful dose, and there are 60 Grams in a two-ounce bottle.

For example: In the above prescription we can see at once that each teaspoonful dose of the mixture contains 15 grains of bismuth subnitrate, 10 grains of mucilage of acacia, etc.

EXAMPLES OF PRESCRIPTIONS OF SOLID MEDICINES

Example

June 5, 1900

For Mr. Winsley

R̄

Extracti Colocyntidis Compositae 3ss

Rhei grs. xxiv

m. et divide in pilulas No. XII

Sig. one o. n.

Dr. Jamestain

This prescription reads:

Take thou, of compound extract of colocynth $\frac{1}{2}$ dram, and of rhubarb 24 grains, mix them together, and divide the mass into twelve pills. Each pill therefore contains $\frac{1}{12}$ of the whole amount, or 10 grains of the compound colocynth powder and 2 grains of the rhubarb.

Example

April 7, 1899

For Mr. Hestar

R̄

Tabellarum Morphinae Sulphatis aa 0.015

D. tales dos. Nos. XX

Dr. Sesley

This prescription reads, take thou of morphine sulphate tablets, each to contain 0.015 (15 milligrams). Give twenty such doses.

Example

May 17, 1895

For Mr. Hillston

R̄

*Pyramidon 0.1

*Phenacetine 0.2

Caffeinae 0.06

Sacchari Lactis 0.3

D. tales dos. No. XX et pone in scat.

M. et fiant in chart.

Sig. one t. i. d.

Dr. Lestertan

* These common names are frequently used in prescriptions.

This prescription reads:

Take thou, of pyramidon 1 decigram, of phenacetine 2 decigrams, of caffeine 6 centigrams, and of milk sugar 3 decigrams. Mix the ingredients together into a powder, and put twenty such powders in a box. Give one powder three times a day

PART II.—LOCAL REMEDIES

skin

CHAPTER IX

DRUGS ACTING CHIEFLY ON THE SKIN

Drugs may produce two kinds of effects: local and general effects. Local effects are those produced at the site of application, while general effects are effects in the functions of the body which apparently have no relation to the site at which the drug is applied.

The drugs which act principally on the skin produce local visible effects, which are therefore easily understood.

They may be divided into the following groups: Counter-irritants, and Demulcents, Emollients and Protectives. Counter-irritants are used to irritate the skin and to produce other remote effects. Demulcents, emollients and protectives are substances which soothe and protect the skin.

Physiology of the Skin

The skin has several functions, protective, excretory and heat eliminating. The protective function is to protect the underlying structures. The excretory function of the skin consists in the elimination of waste products through the perspiration. The skin eliminates heat by the evaporation of the perspiration and by radiating the heat from the overheated blood in the blood vessels of the skin. The skin also secretes an oily substance which acts as a lubricant. It also contains very fine nerve endings, which receive various sensations, such as touch, temperature, heat, cold, pain, etc.

Drugs may stimulate the functions of the skin or they may lessen the functions of the skin. In addition, they may irritate the skin or may protect it—by preventing the contact of injurious substances with the skin.

The substances that irritate the skin are called counterirritants because they are used to lessen irritation in other parts of the body.

Local Effects of Drugs on the Skin

A stimulating effect on the skin would consist of increased perspiration, increased sensitiveness and an increase in its oily secretion. Practically, however, any drug that could produce such a local effect would have to be applied all over the body; which is not feasible. Increased perspiration may result from hot baths or hot packs. There are some drugs that can be given hypodermically to produce such effects.

MATERIA MEDICA

COUNTERIRRITANTS

Counterirritants or skin irritants are drugs which are used principally for their effects on the skin. They produce two kinds of effects: local and remote.

→ **Local Effects.**—The local effects are those produced at the site of application, and depend upon the length of time the drug is applied, or upon the strength of the preparation used. Thus, a weak preparation applied for a short time produces only redness; if the same preparation is allowed to remain on the skin for a longer time, or if a stronger preparation is used, a blister will form. A still stronger action consists in the destruction of the skin, (caustic or escharotic action).

Remote Effects.—The remote effects produced by counterirritants are of two kinds: **circulatory** and **reflex**.

The circulatory effects are due to the dilated capillaries. This brings **more blood to the surface of the skin** from the underlying or deeper tissues and organs, which then become anaemic. Thus, by removing some of the blood from deeper organs, counterirritants relieve inflammation or congestion. For example, the application of a mustard plaster to the chest will often relieve bronchitis (inflammation of the bronchi) by withdrawing the blood from the inflamed bronchi to the surface of the skin.

The reflex effects are due to the action on the nerve areas in the skin which are associated with those of the deeper organs. By affecting these nerve endings, pain in some of the deeper organs may be relieved. For example, the application of a flaxseed poultice to the upper part of the abdomen often relieves various pains in the stomach. The other reflex effects of counterirritants are a slight increase in the blood pressure and momentary deeper breathing; but these effects are very slight.

The counterirritants are best classified according to the effects they produce in the usual strengths which are commonly used, though the same effects can be obtained from all of them.

- 1. **Rubefacients:** Drugs that produce redness of the skin.
- 2. **Vesicants:** Drugs that produce blisters on the skin.
- 3. **Caustics or Escharotics:** Drugs that destroy the skin.
- 4. **Pustulants** are drugs now seldom used, which form pustules.

The counterirritants may be used either for their local effect on the skin or for their effects on the deeper organs.

RUBEFACIENTS

The rubefacients are used principally to redden the skin, to relieve congestion of the underlying tissues and to relieve pain in remote organs. Heat, cold applications and cupping may produce the same effects.

SINAPIS—MUSTARD

Mustard is the powdered dried ripe seeds of *Brassica alba* and *Brassica nigra*, which are European plants growing in temperate climates throughout the world. There are two kinds of mustard: *Sinapis Alba* (White Mustard) and *Sinapis Nigra* (Black Mustard). The black mustard is usually much stronger than the white.

The active principles of mustard are a ferment **myrosin** and a glucoside **sinalbin**, in white mustard, and **sinigrin**, in black mustard.

When water is added to black mustard, it is decomposed; the myrosin acts on the **sinigrin** and changes it to dextrose, a sugar, and the **volatile oil of mustard**, which is the active ingredient. In a similar way the white mustard is also decomposed. The myrosin acts on the **sinalbin**, changing it to dextrose, a sugar, and an alkaloid, **sinapine sulphate**.

ACTION

Local Action: Applied to the skin, mustard makes it red and warm (rubefacient action), because it widens the capillaries. It thus draws blood to the surface from the deeper tissues or organs. If the application is left on for a long time, or if the preparation is very strong, blisters are formed (vesicant action). If the application is allowed to remain on the skin for a still longer time, pustules may form, and the skin may even be destroyed at the site of application (caustic action).

Internal Action

In the stomach, small quantities of mustard increase the appetite and the secretion of gastric juice, and therefore aid the digestion of food. For this purpose, mustard is commonly used as a condiment with food.

The doses in which mustard is usually prescribed, produce nausea and vomiting. It is used for this purpose especially in cases of poisoning from various drugs.

Methods of Administration

For Local Applications :

(1) **Plaster:** This comes in small square leaves ready for use. It is dipped in luke-warm water and applied.

(2) **Mustard paste:** This is usually made up with flour, using one part of mustard to four parts of flour. It must be made with tepid water, as hot water, alcohol and vinegar prevent the formation of the active oil which is formed and no effect then results from the application.

The paste should not be applied directly to the skin, but by means of a piece of thin gauze or lint.

(3) **Powdered mustard** may be sprinkled over an ordinary poultice and the poultice then applied to the skin.

Local applications of mustard should not be left on longer than fifteen to thirty minutes.

(4) **Mustard baths** are common methods of administering mustard for a local effect and to relieve congestion of internal organs. About two to four teaspoonfuls of the dried powder are added to each gallon of water.

Preparations

White Mustard powder
(*Sinapis Alba*)

Black Mustard powder
(*Sinapis Nigra*)

Mustard Paper or Mustard Plaster
(*Charta Sinapis*)

This consists of black mustard powder, to which India rubber is added to make it more adhesive, and the mixture is then applied to sheets of paper and dried.

→ TURPENTINE (TEREBINTHINA)

Turpentine or white turpentine, terebinthina, is a thick resinous substance, or solid oleoresin obtained from the sap of the *Pinus palustris* and other species of pine trees.

There are two kinds of turpentine: **turpentine** or **white turpentine** and **Canada turpentine** or **Canada balsam**.

Canada turpentine, *terebinthina canadensis*, or Canada balsam, or balsam of fir, is a liquid oleoresin obtained from the *Abies balsamea*, the American silver fir, or balm of gilead tree, which grows in the northern parts of the United States. This form of turpentine is seldom used. The turpentines contain a volatile

oil, oil of turpentine, or spirit of turpentine, which produces the effects.

Local action: Turpentine or the spirit of turpentine reddens the skin. If it is kept on the skin for any length of time, it causes blisters.

Uses

- Turpentine is applied to the skin to relieve pain and to withdraw blood from the deeper tissues; occasionally to form a blister.
- To increase the flow of urine.
- To expel gas from the intestines.
- To increase cough and expectoration, and to check the growth of bacteria in the lungs.

Overdoses may cause nausea, vomiting, diarrhoea and painful, scanty urine.

Administration.—For its effects on the skin, turpentine liniments are used, or the drug is applied in the form of a “stupe.”

Internally, turpentine is best given in capsules or in an emulsion. As an expectorant, it is frequently given by inhalations. It is often added to enemas to help the expulsion of gas.

→ Turpentine Stupe

A turpentine stupe is applied by dipping a piece of flannel in hot water, to which a few drops of hot turpentine oil have been added. The flannel is wrung out and applied over the skin, which should be covered with vaseline to prevent the formation of blisters. Another method of applying turpentine consists of painting the skin of the abdomen with a mixture of one part of turpentine to two parts of an oil, such as olive or cotton seed oil. A piece of flannel which has been wrung out of hot water is then applied over the painted area of skin.

Preparations

Oil of Turpentine	0.3–1.0 c.c.	m. v–xv
(<i>Oleum Terebinthinae</i>)		

This is obtained by distilling turpentine.

Turpentine Liniment
(*Linimentum Terebinthinae*)

→ OTHER RUBEFACIENTS

→ CAPSICUM

Capsicum or cayenne pepper is the extremely pungent fruit of the **African Pepper** or *Capsicum fastigiatum*. Strong preparations cause redness of the

skin and blisters when applied locally. It is used in the form of a plaster, like mustard.

FLAXSEED (*Linum*)

Flaxseed or linseed is the dried ripe seeds of the flax plant.

Flaxseed meal is the ground dried seeds of the flaxseed plant, which is used principally as a poultice. The seeds themselves are often given in the form of flaxseed tea to relieve bronchitis and painful urination.

ARNICA

Arnica is obtained from the flowers of the *Arnica montana*, or leopard's bane, a plant growing in northern Europe.

It is commonly used in the form of a tincture as a counterirritant in bruises.

LINIMENTS

Chloroform Liniment
Camphor Liniment
Ammonia Liniment

These are preparations for local use of substances used principally for other effects.

VESICANTS

Vesicants or Epispastics are drugs used to produce blisters. In this way they withdraw fluid from the deeper tissues into the blister. They are used to produce this effect in joint affections, in various inflammations of the internal organs and for neuralgic pains. They may be absorbed, and may then weaken the patient. They should not therefore be used on very old patients or on infants.

CANTHARIS (*CANTHARIDES*)

Cantharides or Spanish fly is a dried beetle found in various temperate climates, especially in Spain and Italy. Its active principle is a neutral substance, **cantharidin**.

Applied to the skin: it causes redness and swelling with the formation of a blister. **Internally**, in small doses it increases the flow of urine. It is said to increase sexual desire.

Poisonous Effects: Absorption of cantharides from the skin, or when taken internally in large doses, produces the following symptoms; which are due to the injury of the kidneys and alimentary tract.

1. Profuse vomiting and diarrhoea.
2. Painful urination, with scanty urine, which often contains blood; and collapse.

Administration

Cantharides is frequently applied in the form of a plaster: a small piece of the plaster, the size of a dime is applied over the affected area.

Before applying cantharides, the skin should be shaved, cleansed with soap and water, alcohol and ether. The plaster is then applied and left on for about 4 to 8 hours, depending upon the effect desired.

Preparations

Cerate of Cantharides
(*Ceratum Cantharidis*)

Cantharides Collodion
(*Collodium Cantharidatum*)

Cantharis Vittata: This is the dried potato fly which contains cantharidin. It is occasionally used as a substitute for cantharides.

✓ PUSTULANTS

Pustulants are drugs which produce very violent action on the skin with the formation of a group of pustules. They are not used very frequently. The remedies which were formerly used for this purpose were Croton Oil and **Antimony**.

✓ CAUSTICS OR ESCHAROTICS

Caustics or escharotics are drugs which are applied locally to destroy tissues. The destroyed tissue is called the **slough** or **eschar**. The action may be mild or severe. The drugs that have a mild action are used principally in the treatment of various skin diseases and for the removal of scars.

The substances that are more destructive to the tissues are used principally to destroy infected tissue, such as the bite of an animal, and to remove warts.

MILD CAUSTICS

CHRYSAROBIN

Chrysarobin is a substance obtained from cavities in the **Andira araroba**, a tree growing in India and Brazil. Its active principle is **chrysophanic acid**.

When applied to the skin, it causes redness, pain and even swelling. Large doses, when absorbed from the skin or when taken internally, cause nausea, vomiting, diarrhoea and scanty, bloody urine.

It is used principally in 4% ointments for the treatment of various skin diseases.

Araroba or Goa Powder

This is the crude powder from which chrysarobin is made.

SCARLET RED

This is a chemical dye which is said to increase the formation of granulation tissue (newly forming scar tissue). It is used for this purpose in 4-10% ointments in the treatment of wounds and ulcers.

THIOSINAMINE

Thiosinamine is a crystalline, colorless substance made from the oil of mustard, by the action of an alcoholic solution of ammonia. Chemically, it is called allyl sulpho-carbamide, allyl thiourea, or rhodamine.

It is believed to absorb scar tissue in various parts of the body. It is

therefore used to remove scar tissue in the eye, the skin, the stomach, the urethra, etc.

Thiosinamine is used locally in the form of plasters or ointments containing 10% of thiosinamine.

It is usually given hypodermically, however, in 10% or 15% solutions, and occasionally it is given by mouth in capsules.

Thiosinamine	0.03-0.1 Gm.	gr. $\frac{1}{2}$ - $1\frac{1}{2}$
(Thiosinamina)		

Fibrolysin

Fibrolysin is a salt made from thiosinamine. Chemically it is thiosinamine sodium salicylate. Its action is the same as that of thiosinamine but it is more quickly absorbed.

It is given hypodermically, intramuscularly, or intravenously for the absorption of scar tissue in various parts of the body.

Fibrolysin usually comes in small glass vials, each containing 2.3 c.c. of fibrolysin, which is equivalent to 0.2 Gm. (gr. iii) of thiosinamine.

STRONG CAUSTICS

Alkalies

Potassium Hydroxide

Sodium Hydroxide

Acids

Nitric Acid

Glacial Acetic Acid

Trichloroacetic Acid

Chromic Acid

These are substances used to cauterize infected tissues.

Metals

Silver Nitrate

Copper Sulphate

Alum

PROTECTIVES

Protectives are substances which soothe or protect the skin and lessen irritation. They are divided into two groups:

1. **Demulcents:** Drugs which soothe or protect the skin.
2. **Emollients:** Drugs which soften the tissues.

DEMULCENTS

Demulcents are bland substances which are used to soothe inflamed tissues. They are also used to suspend substances which cannot otherwise be dissolved, in mixtures.

The demulcents are all sticky substances which swell up into jelly-like masses when they are dissolved in water. They prevent the tissues from coming in contact with irritating substances

and in this way they relieve the pain of inflammations and protect the tissues.

Preparations

ACACIA or GUM ARABIC: This is the gummy sap obtained from the *Acacia senegal*, an African tree. It contains **calcium** combined with **arabic acid**. It is used in making emulsions of various drugs and pills.

Mucilage of Acacia 16.0 c.c. 3iv
(*Mucilago Acaciae*)

This contains one part of acacia to two parts of water.

TRAGACANTH: This is a gummy sap obtained from the *Astragalus gummifer*, an Oriental tree. It is principally used to suspend heavy powders in water and in making of pills.

Mucilage of Tragacanth 16.0 c.c. 3iv
(*Mucilago Tragacanthae*)

ULMUS or ELM: This is the inner bark of the *Ulmus fulva* or slippery elm tree of the United States. When mixed with water it forms a mucilage-like substance which is very soothing to the tissues. It is often used in the form of a poultice.

Mucilage of Elm
(*Mucilago Ulmi*)

ALTHEA: This is obtained from the root of *Althaea officinalis* or marsh-mallow.

SASSAFRAS MEDULLA: This is the pith of *Sassafras varifoliorum*. The mucilage of sassafras is principally used to soothe inflammations of the eye, and is occasionally given internally.

GLYCYRRHIZA (Licorice Root): This is the root and underground stems of the *Glycyrrhiza glabra*, an English plant. It is used principally to soothe mucous membranes. It has a very pleasant taste because of its active glucoside, **glycyrrhizin**, and it is used for this reason to flavor medicines.

➤ **AMYLUM:** This is ordinary starch which is used in the form of a dusting powder or is boiled in water and then applied as a demulcent.

Glycerite of Starch (Plasmine)
(*Glyceritum Amyli*)

AMYGDALA DULCIS (Sweet Almonds). This is the seed of *Prunus amygdala dulcis* or the almond tree. It contains a fixed oil and a ferment, **emulsin**. When the almonds are rubbed together with water, a bland emulsion is formed which is very soothing to the tissues.

CHONDRUS (Irish Moss or Carrageen): This is obtained from *Chondrus crispus*, a seaweed found on the coasts of Ireland and Massachusetts. It forms a jelly-like mass when dissolved in water because of a starchy substance, **carrageenin**, which it contains. Various preparations of chondrus such as **lubrichondrin**, are used as lubricants for the passage of catheters or other instruments.

KAOLINUM (Kaolin): This is a powder which consists of silicates, various salts of silicon, an element. This powder has the property of withdrawing fluid from tissues. It is used in the nose in powder form to remove purulent secretions.

It is used in the intestinal tract to absorb secretions and bacteria, in colitis and in food poisoning; and to protect the intestines when chronic inflammation or ulcers are present. It is also given to check the action of digestive ferments.

Cataplasma Kaolini: This is a clay-like poultice consisting of boric acid, methyl salicylate, glycerine, thymol, oil of peppermint, and kaolin. It withdraws fluid from the tissues and is very soothing. It is on the market under various names; such as Antiphlogistine, Fuller's Earth, etc.

→ **TALCUM:** This is magnesium silicate and is used as a bland soothing dusting powder.

^{Ky jelly}
LYCOPodium: This consists of the spores of *Lycopodium clavatum* or club moss. It is used principally as a soothing dusting powder and in making of pills.

EMOLLIENTS

Emollients are bland fatty substances used to soften the skin and as mediums for other drugs applied locally to the skin.

Preparations

ADEPS (Lard): This is the prepared internal fat of the abdomen of the pig. It is purified by washing, melting and straining.

→ **Benzoinated Lard**
(Adeps Benzoinatus)

Ointment
(Unguentum)

This is a mixture of lard and yellow wax and forms the basis of other ointments.

SEVUM PRAEPARATUM (Suet): This is obtained from the abdominal fat of the sheep.

→ **ADEPS LANAE HYDROSUS (Wool Fat or Lanolin):** This is the purified fat of sheep's wool. It mixes easily with watery solutions and is readily absorbed by the skin.

→ **PETROLATUM:** This is made from petroleum after its more volatile constituents are distilled. It is used principally in ointments to soften the skin. Several of the paraffins which do not melt readily are used in surgery for cosmetic purposes.

Petrolatum or Petroleum Jelly

White Petrolatum
(Petrolatum Album)

Vaseline, Albolene, etc., are trade names for petrolatum.

➤ **OLIVE OIL** (*Oleum Olivae*): This is a fixed oil obtained from the olive, the ripe fruit of *Olea Europea*; a European tree.

OLEUM LINI: This is the fixed oil of linseed or flaxseed.

➤ **OLEUM THEOBROMATIS** (*Cocoa Butter*): This is the fixed oil expressed from the roasted cocoa bean *Theobroma cacao*. It is used principally to make suppositories.

➤ **OLEUM GOSSYPI SEMINIS** (*Cotton Seed Oil*): This is the fixed oil expressed from the seeds of the cotton plant.

CETACUM (*Spermaceti*): This is a fatty substance obtained from the head of the sperm whale. It is used to give consistency to many ointments such as cold cream.

➤ **CERA** (*Wax*): This is wax obtained from the honeycomb of the bee. It comes in two forms: white yellow wax and white wax. It is used in making ointments, cerates and plasters.

CERATUM: This is a mixture of 3 parts of wax and 7 parts of lard.

➤ **GLYCERINUM** (*Glycerin*)

Glycerin is a liquid made by decomposing animal or vegetable fats.

When applied to the skin or a wounded surface, glycerin smartens and is painful for a few minutes, but it softens the skin if the application is continued. It has the property of withdrawing fluid from the tissues (hygroscopic).

It is often given internally or it is injected into the rectum. It then produces mild movements of the bowels without any colic.

Glycerite of Starch
(*Glyceritum Amyli*)

Glycerite of Egg Yolk
(*Glyceritum Vitelli*)

There are a number of preparations of various drugs made up with glycerin. They are known as glycerites.

SUBSTANCES USED AS DRESSINGS

The following substances are used to protect the tissues, to keep out infectious material, light or air.

➤ **COLLODIUM** (*Collodion*): This is a 4% solution of pyroxylin or soluble gun cotton in alcohol and ether. When collodion is applied to the skin, the alcohol and ether evaporate, leaving a colorless transparent contractile film, which is strongly adherent to the skin and protects it.

Flexible Collodion
(*Collodium Flexile*)

This contains Canada turpentine and castor oil in addition to the other ingredients and is more pliable.

Styptic Collodion
(*Collodium Stypticum*)

This contains 20% of tannic acid and is therefore astringent.

SURGICAL PARAFFIN OR PLASTIC PARAFFIN

Paraffin is a wax-like substance made from petroleum, which melts at 50° C. It is solid at ordinary room temperature, but melts on heating.

Paraffin is used as an excellent local application for burns, frostbite, chilblains or ulcers of the leg. It acts mechanically by coating the burn or ulcer with a fine film, which excludes the air. At the same time this film acts as a sort of thin splint, thus allowing new tissue to grow over the area.

Method of Application

The paraffin is melted. The wound surface is thoroughly dried, preferably by a spray of warm air applied with an electric drier. The melted paraffin is then applied over the surface with a camel's-hair brush or atomizer. A very thin layer of cotton is then applied over the paraffin and another layer of paraffin is applied over that. More cotton is placed over this paraffin and the part is then bandaged.

Paraffin

Paraffinum

Stanolind Surgical Wax

This is a specially prepared brand of paraffin.

Parresine

This is a mixture composed of paraffin, Japan wax, gum elemi, asphalt and eucalyptol. It is said to be better than ordinary paraffin.

ELASTICA (India Rubber or Caoutchouc): The dried milky juice of a Brazilian tree. It is known as Para rubber. It is used in making adhesive plaster, bougies, etc.

CALCIUM SULPHIDE, DRIED (Calcii Sulphas Exsiccatus)

This is dried gypsum or plaster of Paris. When dissolved in water it forms a thick gelatinous mass, which becomes hard when exposed to the air. It is used in the form of a gelatinous mass or as bandages filled with the dried powder.

8-9-10-
**PART III.—DRUGS USED PRINCIPALLY FOR THEIR
EFFECTS ON THE STOMACH OR INTESTINES**

Thi
CHAPTER X

ACIDS AND ALKALIES

ACIDS

Acids are very sour substances, either fluid or solid, which consist of several chemical elements combined with hydrogen. The hydrogen can be replaced by an alkali, thus forming a salt. The acids are divided into two groups: **inorganic or mineral acids** and **plant or organic acids**. The inorganic or mineral acids are prepared from mineral elements while the organic acids are prepared from plants and contain carbon. Most of the inorganic acids are very poisonous substances unless they are given in very dilute solutions.

INORGANIC OR MINERAL ACIDS

The mineral acids principally used in medicine are dilute hydrochloric, sulphuric, nitric, nitrohydrochloric, and phosphoric acids.

ACTION

Local action: Applied to the skin, or mucous membranes, concentrated solutions of acids are very injurious to the tissues, and destroy the skin, mucous membranes and underlying tissues. The tissues become shrunken, hard and brittle, because the acids withdraw water from the tissues with which they come in contact.

Dilute solutions of the acids usually **contract mucous membranes**.

Internal Action

In the mouth: The dilute solutions ordinarily used have a characteristic sour taste and relieve thirst. They increase the flow of saliva and contract the mucous membrane of the mouth.

In the stomach: The acids aid the digestion of protein or albuminous food, since the pepsin acts only in the presence of an

acid, particularly hydrochloric acid. They also increase the flow of pancreatic juice.

Excretion

The acids are eliminated from the body in the urine, as acid salts which increase its acid reaction. They are often slightly irritating to the kidneys, causing albumin or blood in the urine. The patient may have burning pain in the bladder when passing urine.

Administration

All the acids should be given before or with meals, well diluted, sipped very slowly through a glass tube, so as not to injure the teeth. Diarrhoea and griping pains in the abdomen are symptoms of excessive action.

Poisonous Effects

Acute acid poisoning usually results from an acid taken with suicidal intent. The poisonous effects of all the acids are the same, except that hydrochloric and nitric acids make the tissues yellow and hard, while sulphuric acid turns the tissues white in color and then brown.

Symptoms

1. **Severe burning pain in the mouth, throat and stomach.** The tissues about the mouth become dry, shrunken, white or yellow in color, depending on the acid taken. Nitric and sulphuric acids are the most corrosive.

2. **Profuse vomiting and diarrhoea.** The vomited matter contains blood and pieces of mucous membrane.

3. **Profound collapse** (rapid, thready, weak pulse, slow, shallow breathing, subnormal temperature). Death usually occurs in several hours.

Frequently, as a result of lessening the alkaline salts in the blood, there occurs:

4. Difficult breathing.

5. Twitchings of the muscles or convulsions.

Occasionally the fumes of the acid may cause swelling of the larynx (oedema of the glottis), and the patient may then die of asphyxia.

If the patient recovers, he may suffer from various symptoms produced by the narrowing (stenosis) of the oesophagus because of the scar tissue formed by the healing.

Treatment

1. Neutralize the acid with an alkali, such as **magnesia or magnesium carbonate, sodium bicarbonate, or lime water.**

Sodium bicarbonate should be used cautiously, as it may form carbon-dioxide gas and distend the stomach.

If these substances cannot be obtained, chalk, plaster from the wall, soapsuds, etc., may be used. Giving plenty of water helps to dilute the acid. The stomach may be washed out, but with great care, as the stomach tube may pass through the injured stomach wall.

2. Protect the mucous membranes of the oesophagus and stomach by white of egg, milk, flour and water, etc.

3. Keep the patient quiet.
4. The collapse is treated with heart stimulants, such as caffeine, strychnine, atropine, etc.
5. Sodium bicarbonate solutions are given intravenously or by rectum to increase the alkaline salts in the blood.

PREPARATIONS OF MINERAL ACIDS

> DILUTE HYDROCHLORIC ACID

Dilute hydrochloric acid is used principally to aid digestion in cases where there is an insufficient amount of hydrochloric acid secreted in the stomach; and the pepsin is then unable to digest the food. This often occurs in such diseases as chronic gastritis, or in infectious diseases.

It is also used to lessen thirst, especially in fevers, and to check intestinal putrefaction and diarrhoea.

→ Dilute Hydrochloric Acid 0.3-2.0 c.c.
(Acidum Hydrochloricum Dilutum)

m. v-xxx *done*

This contains 10% of hydrochloric acid.

Oxyntin 0.3-1.0 Gm.

grs. v-xv

This is a solid preparation, a compound of protein and hydrochloric acid and is used as a substitute for the latter substance for the digestion of proteins. It is only half as strong as dilute hydrochloric acid.

Betaine Hydrochloride 0.6-1.0 c.c.

m. x-xv

This is an alkaloid found in beets and other plants. When it is given in watery solutions it is decomposed into betaine and hydrochloric acid. It is used instead of dilute hydrochloric acid when it is absent in the stomach.

For Local Use

Hydrochloric Acid

(Acidum Hydrochloricum)

This contains 31% of hydrochloric acid.

> SULPHURIC ACID (OIL OF VITRIOL)

Sulphuric acid acts like the other acids, except that it checks intestinal secretions and the sweat.

It is rarely used except as a remedy for lead poisoning and occasionally to check diarrhoea and night sweats. The concentrated acid is occasionally used to destroy an infected area of the skin (caustic action).

Dilute Sulphuric Acid 0.6-2.0 c.c.
(Acidum Sulphuricum Dilutum)

m. x-xxx

This contains 10% of sulphuric acid.

Aromatic Sulphuric Acid 0.3-1.0 c.c.
(Acidum Sulphuricum Aromaticum)

m. v-xv

This contains 20% of sulphuric acid in alcohol, flavored with ginger and cinnamon.

For Local Use

Sulphuric Acid
(Acidum Sulphuricum)
 (Oil of Vitriol)

This contains 92% of sulphuric acid.

➤ **NITRIC ACID (AQUA FORTIS)**

Nitric acid acts like other acids, except that it is said to increase intestinal secretions and the secretion of bile. It is occasionally used instead of hydrochloric acid to aid digestion. A drop of the strong acid is frequently applied on the skin to destroy an infected area.

Dilute Nitric Acid	0.6-2.0 c.c.	m. x-xxx
(Acidum Nitricum Dilutum)		

This contains 10% of nitric acid.

For Local Use:

Nitric Acid
(Acidum Nitricum)

This contains 68% of nitric acid.

Dilute Nitrohydrochloric Acid	0.3-1.0 c.c.	m. v-xv
(Acidum Nitrohydrochloricum Dilutum)		

This contains 40 parts of nitric acid and 180 parts of hydrochloric acid in 1000 c.c. of water. It was formerly used to increase the flow of bile.

➤ **PLANT OR ORGANIC ACIDS**

The plant or organic acids are obtained from various fruit juices such as the grapes, lemons, or by the prolonged fermentation of wines.

Their effects are similar to those produced by the mineral acids, but they are milder, and they act as alkalies after absorption. They do not produce poisonous effects, except when given in very large doses. The organic acids commonly used are acetic, citric and tartaric acids. The acetic acid is the most active one in the group; the others have a milder action.

ACTION

1. All organic acids have a sour taste.
2. They increase the flow of saliva and relieve thirst.
3. They increase the appetite and the flow of gastric juice and thereby aid digestion.
4. They slightly increase bowel movements, for example, the juice of half a lemon given before breakfast is a good laxative.
5. They increase the alkalinity of the blood.
6. They increase the flow of urine.
7. Continued use of organic acids causes anaemia and loss of weight.

PREPARATIONS OF ORGANIC ACIDS

➤ DILUTE ACETIC ACID

Acetic acid is an organic acid formed by the prolonged fermentation of various fruits and vegetables. Thus, when wine is fermented for a long time, vinegar is formed, which consists mostly of acetic acid.

Vinegar

Acetum

Vinegar is obtained by prolonged fermentation of alcoholic liquors. The best vinegar is made from cider, and consists mostly of acetic acid.

Dilute Acetic Acid 2.0–8.0 c.c.
(**Acidum Aceticum Dilutum**)

3½–ii

This is a pure form of vinegar which contains 6% of acetic acid.

These preparations are used principally to harden the skin, to check bleeding; and by inhalation, to relieve fainting (reflexly strengthening the heart action in this way). They are also used to neutralize poisoning from alkalies.

➤ CITRIC ACID

Citric acid is an organic acid which is found in the juice of the lemon, or *Citrus limonum*, and the lime, *Citrus bergamia*.

Citric acid is frequently given on shipboard as an article of diet, to prevent scurvy, a severe disease of the joints due to the lack of vitamins from vegetable food in the diet.

It is not a poisonous substance, but its continued use occasionally causes anaemia and loss of weight.

Citric Acid

(**Acidum Citricum**)

This is occasionally used in doses of 30.0 Gms. (℥i), to a pint of water; instead of lemonade. The best way to administer citric acid is in the form of lemonade. To produce sweating it is best given hot.

TARTARIC ACID

Tartaric acid is the acid of grape juice. Its action is similar to that of acetic acid. It is principally used to increase the flow of urine, in which it is excreted as alkaline carbonates. It is also used as a laxative, and it is an ingredient of the seidlitz powder.

Tartaric acid is usually given in the form of grape juice, as a cooling refreshing drink. As a diuretic or laxative, its various salts such as potassium tartarate, etc., are preferred.

OXALIC ACID

Oxalic acid is an organic acid, found in sorrel and other vegetable substances. It is never used as a medicine, but potassium oxalate, or essential salt of lemon, and oxalic acid are frequently used to clean metal kitchen utensils. These salts resemble epsom salt in appearance, and are a frequent cause of severe poisoning, when taken by mistake, or with suicidal intent. The oxalic acid combines with the calcium of the blood causing muscular twitchings or convulsions in addition to the usual symptoms of poisoning by acids (see page 142).

7 ALKALIES AND ALKALINE EARTHS

An alkali is a substance which belongs to a group of chemical substances called bases. They are all characterized by containing the radical OH. Since they are principally used in medicine to neutralize acids, they are frequently called **antacids**.

Alkalies have the following properties:

1. They combine with acids to form salts.
2. They turn red litmus paper blue.
3. They turn phenolphthalein red.
4. They combine with fats to form soaps, and they dissolve proteins.

Any substance which has these properties is called a base, or alkali.

An alkaloid is a vegetable substance which has similar properties.

The substances commonly used as alkalies are the salts of **sodium, potassium and ammonium**.

The alkaline earths are the salts of **calcium, magnesium, lithium and bismuth**.

The alkalies are divided into the mild alkalies, such as sodium bicarbonate and the alkaline earths, and the caustic alkalies, such as sodium and potassium hydroxide, the latter is used only for local effects.

All the alkalies have practically the same effects but they vary in degree. Since the most commonly used alkali is sodium bicarbonate, its effects will be described as a type.

7 SODIUM BICARBONATE

Sodium bicarbonate or baking soda is a white powder obtained by the chemical reaction of sodium chloride and ammonium hydrogen carbonate made by what is known as the Solvay process.

ACTION

Local action: Concentrated solutions of the strong alkalies destroy the skin and underlying tissues, forming a soft crust, leaving an ulcer when it falls off. Weak solutions make the skin feel soft and soapy. Applied to wounds and on mucous membranes they dissolve the inflammatory secretions and mucus.

In the stomach: Sodium bicarbonate, as well as all alkalies, combines with and neutralizes the hydrochloric acid in the stomach, thus forming sodium chloride. It also checks fermentation, neutralizes the organic acids formed in the stomach by fermentation and dissolves mucus.

When large doses of the alkalies are given, some of the alkalies pass into the intestines, where they dissolve mucus, absorb fluid from the tissues and act as saline purgatives.

Action after absorption: The sodium chloride which is formed in the stomach is absorbed into the blood, where it increases the sodium content of the blood, thus increasing its alkalinity, and neutralizing the acid substances which are formed in the condition known as acidosis.

Excretion: All the alkalies are eliminated in the urine, which they make alkaline in reaction.

Uses

Locally, solutions of sodium bicarbonate are applied to burns, eczema, and other skin diseases, as a soothing application to dissolve crusts and secretions. Sodium bicarbonate forms an important ingredient of most mouth washes, gargles and tooth pastes, because of its ability to dissolve mucus.

Internally, it is used principally in conditions of hyperacidity and ulcer of the stomach, for the purpose of neutralizing the excess of acid. It therefore lessens the pain produced by the spasm at the pylorus, which results from the excess of acid. It is also given to check nausea and vomiting and fermentation in the stomach, even when no excess of hydrochloric acid is evident.

Sodium bicarbonate is extensively used for the treatment of the condition known as acidosis. This is a group of symptoms which result when the alkaline reaction of the blood is diminished by the presence in the blood of various acids such as oxybutyric acid, which are formed when fats are not completely burned up in the body. When these acids are present in the blood in excess, acetone and diacetic acid appear in the urine and can be recognized on the examination of the urine. A normal alkaline reaction of the blood is essential to life and when the alkalinity is diminished the symptoms of acidosis occur. Acidosis occurs in diabetes, delayed chloroform poisoning, uremia and starvation. The symptoms occur gradually and consist principally of headache, vomiting, a peculiar type of breathing, and finally coma and death.

Acidosis is treated by giving the patient large doses of sodium bicarbonate so as to increase the alkaline condition of the blood by neutralizing the excess of acid substances in the blood.

Administration

Locally sodium bicarbonate is applied in solutions of various

strengths, usually combined with other remedies. In stomach cases when it is given for excessive acid, it should be given in vichy, seltzer or warm water after meals. Frequently it is given in capsules or powders combined with other alkalis such as bismuth or magnesia. For gaseous distention (flatulence) it should be given before or between meals in a tumblerful of vichy, seltzer or warm water. It is also given by rectal irrigations to expel gas.

In acidosis, sodium bicarbonate is given by mouth, by rectum or intravenously in very large doses. In mild cases it is given by mouth in doses of 0.6–1.0 Gm. (grs. x-xv) three times a day. In severe cases about 4.0 Gms. (ʒi) is given three times a day, or in 3–5% solutions by rectum by the Murphy or Rectoclysis method. In the very severe cases it is given intravenously in 3–5% solutions about 500 c.c. at a time.

Poisonous Symptoms of Alkalies

Poisoning by alkalies usually occurs when concentrated solutions of alkalies are taken by mistake. Frequently, washing soda or lye is taken by children accidentally.

The following symptoms usually appear rapidly:

1. Swollen white crust around the mouth and lips.
2. Severe abdominal pains with vomiting of blood and pieces of mucous membrane. The oesophagus is usually severely injured.
3. Collapse: rapid, thready pulse; slow, shallow breathing.

If the patient recovers from these symptoms the oesophagus may become narrow (stenosis) due to scar formation, and malnutrition may result because of inability to swallow food. This condition requires surgical treatment.

Treatment

1. Give as an antidote a dilute organic acid, such as lemon juice, vinegar or dilute acetic acid.
2. Protect the mucous membrane by egg albumin, oils or milk.
3. The collapse is treated with heart stimulants, such as caffeine, strychnine, atropine, digitalis, etc., and by keeping the patient warm.

Do not wash out the stomach, since passing a stomach tube may perforate it.

PREPARATIONS OF ALKALIES

Sodium Compounds

Sodium Bicarbonate	0.2–2.0 Gms.	grs. iii–xxx
(Sodii Bicarbonas)		

There are numerous other preparations which contain sodium bicarbonate, such as seidlitz powder; but these are used principally as cathartics.

Sodium bicarbonate solutions cannot be sterilized, since they are changed to sodium carbonate on boiling.

Monohydrated Sodium Carbonate	0.25 Gm.	grs. iv
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(Sodii Carbonas Monohydratus)**Sodium Carbonate** (Washing Soda)**(Sodii Carbonas)**

These two preparations are rarely used internally. Externally they are used to dissolve mucus and other secretions. They are frequently used to clean glass, china, woodwork, etc. They frequently cause poisonous symptoms when taken by mistake.

POTASSIUM COMPOUNDS

The salts of potassium act like the sodium compounds with the following variations in their effects:

1. The salts of potassium when absorbed into the blood slightly weaken and slow the contractions of the heart.

2. They increase the flow of urine more than the sodium compounds.

The potassium salts are very rarely used as alkalies.

Potassium Bicarbonate (saleratus) 0.3–2.0 Gms. grs. v–xxx

(Potassii Bicarbonas)**ALKALINE EARTHS**

The most commonly used alkaline earths are the salts of calcium, magnesium, lithium and bismuth. The salts of calcium are used to increase the coagulability of the blood and to lessen involuntary muscle spasms, as well as for its alkaline effect. The salts of magnesium, besides acting as alkalies in the stomach, are laxatives. The salts of bismuth are used principally locally, as astringents, on ulcers and as dusting powders, and the salts of lithium are used to increase the flow of urine.

ALKALINE EARTHS USED AS ANTACIDS**Calcium Preparations**

Lime Water 30.0–120.0 c.c. ℥i–iv

Solution of Calcium Hydroxide**(Liquor Calcis or Liquor Calcii Hydroxidi)**

This is a saturated solution of calcium hydroxide or slaked lime, containing 0.17% of calcium hydroxide. It is made by washing slaked lime with distilled water and then filtering the resulting solution. It is used to neutralize the acid in the stomach, to soothe pains in the stomach and to lessen nausea and vomiting. When added to milk, it lessens curdling in the stomach and makes the milk more digestible.

Syrup of Lime 1.0–4.0 c.c. m. xv–℥i

Syrup of Calcium Hydroxide**(Syrupus Calcis)**

This contains 5% of lime.

Chalk Mixture 15.0–30.0 c.c. ℥½–i

(Mistura Cretae)

This contains 20 Gms. of chalk suspended in 100 c.c. of water.

Dibasic Calcium Phosphate	0.3-1.6 Gm.	grs. v-xxv
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This substance is neutral in reaction, but it effectively neutralizes the acid in the stomach.

Magnesium Preparations

The preparations of magnesia, which are principally used to neutralize the acid in the stomach are the following:

Magnesium Oxide (Magnesii Oxidum)	0.3-4.0 Gms.	grs. v-3i
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Calcined or Light Magnesia. or Magnesia Usta.

Milk of Magnesia	4.0-16.0 c.c.	3i-3½
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This is a proprietary preparation containing magnesium hydrate. It is used as an antacid and cathartic.

The other preparations of magnesia are principally used as cathartics, under which group they are described.

Dibasic Magnesium Phosphate	} 0.3-1.6 Gm.	grs. v-xxv
Tribasic Magnesium Phosphate		

These are neutral substances which are used to neutralize the excess of acid in the stomach.

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CHAPTER XI

DIGESTANTS

Physiology of the Stomach

The stomach changes certain kinds of food, such as eggs, meat, etc., to simpler substances of a more fluid character by acting on some of their contained essential food principles, the proteins. They can then be more easily acted upon by the digestive juices of the intestinal tract and are then more readily absorbed through the lining membrane of the stomach and intestines. The process whereby the food is changed to simple fluid substances which can be absorbed, is called digestion.

The digestion of the food is partly brought about by means of the gastric juice, which is secreted by the lining membrane of the stomach. This juice contains two ferments: pepsin and rennin, and a very small percentage of hydrochloric acid which change the complex food substances into simpler substances of a more fluid character.

While these changes are going on, the contractions of the involuntary muscles (peristalsis) of the stomach wall, move the food onward into the intestines, so that the stomach is completely emptied in about two hours. At the same time the pylorus of the stomach forms secretin, a substance which enters the blood stream to stimulate the pancreas to secrete its digestive juice.

The functions of the stomach, then, are:

1. **Secretory**, to secrete gastric juice and digest the food.
2. **Motor**, to move the digested food onward, into the intestines for further digestion.

A drug which acts on the stomach may increase one or both of these functions, or it may replace the acid or ferments which may not be secreted in sufficient quantities.

DIGESTANTS

Digestants are powders made from the lining membrane of the stomach or from the digestive glands such as the pancreas. They contain the active ferments of these glands. They may be classified according to the food principles which they digest.

Uses: In cases where the stomach secretes very little gastric juice, or where the secretion of other digestive juices is diminished, the patient is unable to digest food. In such cases the digestion of food can be assisted by giving various ferments which digest the various food substances: proteins, carbohydrates and fats. These ferments replace the gastric or intestinal juices which may be very much diminished or absent.

The digestive ferments are also used to soften dead tissues and membranes.

CARBOHYDRATE DIGESTANTS

Carbohydrates are starchy foods, such as bread, potatoes, and sugars.

The starchy foods are partially digested in the mouth. They are changed to sugars by the saliva, which contains a ferment, **ptyalin**. The digestion of the starchy foods and sugars is completed in the intestines, by the pancreatic juice, which contains the starch-digesting ferment, **amyllopsin**, and by the intestinal juice which contains **invertin**. This ferment completes the digestion of the sugars. The action of starch digesting ferments is usually destroyed by the acid in the stomach.

Preparations

Taka Diastase 0.06—0.3 Gm. grs. i-v

This is a starch-digesting ferment formed by the action of a mould (*Eurotium oryzae*) upon wheat bran. It is named after its discoverer, Takamine, a Japanese.

Taka diastase is very powerful and efficient, but it only acts in the stomach before the normal amount of acid is secreted.

Diazyme Essence 4.0—8.0 c.c. 3i-ii

This is a liquid containing all the amyllopsin of the pancreas without the trypsin or steapsin. It is used to digest starchy foods, when these are not readily digested by the saliva or pancreatic juice.

Diazyme Glycerole 4.0—8.0 c.c. 3i-ii

This acts like the diazyme essence, but the extract is preserved in 60% glycerin.

PROTEIN DIGESTANTS

Proteins are food substances necessary for building tissues. They are contained principally in foods such as meat, eggs and milk.

The proteins are partially digested by the gastric juice, which consists mainly of pepsin and hydrochloric acid. Pepsin can act only in the presence of an acid. Proteins are completely digested by the pancreatic and intestinal juices. The pancreatic juice contains **trypsin**, a ferment which digests proteins completely; **amyllopsin**, a ferment which digests starches completely; and **steapsin**, a ferment which breaks up the fats into very small globules (emulsifies).

Pancreatic juice can act only in the presence of an alkali, but is destroyed by an acid, such as the acid in the stomach.

The intestinal juice contains **erepsin**, a ferment which completes the digestion of the proteins.

PEPSIN

Pepsin is a ferment obtained from the lining membrane of fresh stomachs of healthy pigs. It is used to aid digestion in cases where the pepsin of the gastric juice is diminished or absent.

Pepsin acts only in the presence of an acid; it should always be given with dilute hydrochloric acid. Alkalies destroy its activity and therefore, it should never be given with such substances as sodium bicarbonate.

Preparations

Pepsin	0.3-0.6 Gm.	grs. v-x
Pepsinum		
Essence of Pepsin (Essentia Pepsini)	8.0 c.c.	℥ii

This is an aromatic, slightly acid substance obtained from the stomachs of pigs or calves. It is used to aid digestion and as a means of administering other drugs.

Elixir of Enzymes	4.0-8.0 c.c.	℥ i-ii
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This is a 15% alcoholic solution containing Pepsin and Rennet of the stomach. It is used to aid digestion.

Gastron	4.0-8.0 c.c.	℥ i-ii
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This is a solution prepared from the mucous membrane of the stomach of the pig, preserved in 25% glycerine. It contains the same percentage of acid as the stomach, as well as its ferments. It is used to aid digestion.

Enzymol

This is an extract prepared from the stomachs of freshly killed animals, which contains the pepsin of the stomach, to which 0.2% of hydrochloric acid has been added. It is used as a local application to stimulate healing.

RENNET

Rennet is a ferment which curdles milk secreted by the mucous membrane of the stomach.

Pegnin

Milk Sugar Rennet

About 8.0-12.0 Gms. (℥ii-iiss) of pegnin are added to 1000 c.c. of cool boiled milk. The mixture is allowed to stand for two or three minutes, and is then shaken so as to divide the clot into fine particles, and give it a uniform consistency.

PANCREATIN

Pancreatin is a mixture of all the ferments obtained from the fresh pancreatic glands of the pig. It is used principally to predigest foods, before they are given to the patient, in cases of impaired digestion.

Pancreatin can act only in the presence of an alkali, and must always be given with sodium bicarbonate, as it is destroyed by the hydrochloric acid in the stomach.

When it is given internally, it should be given in pills coated with keratin, a substance which the acid of the gastric juice does not affect, but which is dissolved by the alkaline intestinal juices.

Preparations

Pancreatin	. 0.12-0.3 Gm	grs. ii-v~
(Pancreatinum)		

Peptonizing Powder
(Pulvis Pancreaticus Compositus)

This is used to predigest foods such as milk and eggs.

Each powder consists of 5 grains of pancreatic extract, and 15 grains of sodium bicarbonate.

Pankreon	0.25-1.0 Gm.	grs. iv-xv
Tannin Pancreatin Compound	0.06-0.25 Gm.	grs. i-iv for children

This is a mixture containing the trypsin, amylopsin and steapsin of the pancreatic juice, and about 8% of tannin.

It acts in the intestines, aiding digestion in diseases where the food is not thoroughly digested, because of lessened secretion of the stomach or pancreas. It is also used in diarrhoea, dysentery, marasmus, etc.

Trypsin	0.12-0.3 Gm.	grs. ii-v
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This is the protein digesting ferment of the pancreas.

It is applied in solutions containing sodium bicarbonate, to diphtheritic, or other membranes. It is also given hypodermically, or applied locally in cases of cancer, to digest the cancer cells.

Mixtures of Digestants

Amylzyme	0.12-0.25 Gm.	grs. ii-iv
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This is an extract prepared from the fresh pancreas of the hog.

Holadin	Each capsule contains 0.2 Gm.,	grs. iii.
(Extractum Pancreaticum Integrum)	One capsule, three hours after meals.	

This is an extract of the pancreatic glands which contains all the enzymes: trypsin, amylopsin and steapsin; and a milk curdling ferment. It is used in diseases where the food is not well digested.

Panase	0.12-0.3 Gm.	grs. ii-v
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This is a combination of the digestive ferments of the pancreas, derived from the pancreatic gland of the pig. It is used where starch is poorly digested.

Other Digestive Ferments**Ingluvin**

0.3-1.0 Gm.

grs. v-xv

Ingluvin is the extract of a fowl's gizzard, and is occasionally used to aid in the digestion of proteins.

Papain

Papain is the fruit of the *Carica papaya*, a tree growing in tropical countries. The juice of this fruit contains a ferment, **papain**, **papayotin** or **papoid** which is used to aid the digestion of proteins.

CHAPTER XII

BITTERS, CARMINATIVES AND EMETICS

(Gastric Stimulants)

BITTERS

Bitters are remedies which act locally in the stomach. The effect of any remedy acting locally on the stomach is to produce a slight irritation, characterized by an increased secretion of the mucous membrane. Since the secretion of the mucous membrane of the stomach, however, is a potent digestive fluid, the gastric juice, the effect of such local remedies is to increase the digestion of food and aid the appetite. The various condiments taken with food are the best examples of bitters.

There are two kinds of bitters: **Simple** and **Aromatic**.

Simple bitters are vegetable substances which increase the activity of the stomach, and improve the appetite.

Aromatic bitters are vegetable substances used as bitters, which have a pleasant odor because of volatile oils which they contain.

There are other drugs which cause important effects after absorption, but which may also act as bitters in the stomach; for example, *nux vomica* and quinine.

Poisonous Effects

Occasionally, some of the bitters, such as quassia and berberis, if given in large quantities, may cause diarrhoea, frequent urination, nausea, vomiting, restlessness, and a rapid, weak pulse. These symptoms are due to the alkaloids quassin and berberin, which they contain.

Administration

Bitters should always be given before meals in fluid form. They should be given undiluted and their taste should not be disguised as this may interfere with their effect.

Simple Bitters

GENTIAN.

This the root of the *Gentiana lutea*, or the yellow gentian of the Alps. It is often used as a mild laxative.

Compound Tincture of Gentian
(*Tinctura Gentianae Composita*)

2.0-16.0 c.c.

3½-iv

BERBERIS (Barberry.)

This is a drug obtained from the root and berries of *Berberis vulgaris*, which grows in Europe. It contains an active principle, berberine, an alkaloid, and some tannin, which makes it contract mucous membranes slightly.

Fluidextract of Berberis	2.0 c.c.	m. xxx
(Fluidextractum Berberidis)		

CONDURANGO

This is the bark of the condurango tree.

Other Substances Used as Bitters

Nux Vomica, Cinchona, and their alkaloids, strychnine and quinine, are also used as simple bitters, but their general effects are more important; under which they will be considered.

AROMATIC BITTERS

The aromatic bitters increase the secretion of the stomach more than the simple bitters do, on account of the volatile oils which they contain. Their effects are also more lasting, and they contract the mucous membranes, because of small quantities of tannic acid which many of them contain.

They should always be given before meals, best in fluid form undiluted, and their taste should not be disguised.

Preparations**SERPENTARIA**

This is the root of the Virginia snake root, a small herb, which grows in the United States. It is often combined with other bitters.

Tincture of Serpentaria	2.0-8.0 c.c.	3 $\frac{1}{2}$ -ii
(Tinctura Serpentariae)		

ANTI-BITTERS

Anti-bitters are substances which abolish the bitter taste. They are used principally to disguise the taste of bitter medicines.

Yerba Santa or Eriodycton	4.0 c.c.	3i
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This is given in the form of a syrup or an elixir.

Gymnemic Acid	0.3 Gm.	grs. v.
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This is a white powder which is also used for this purpose.

CARMINATIVES

Carminatives are drugs which check the formation, and aid in the expulsion of gas from the stomach and intestines. The carminatives usually contain volatile oils and are therefore also used as aromatic bitters.

ACTION

Although in strong solutions some of the carminatives such as capsicum may irritate the skin and mucous membranes, and in sufficiently strong solutions they may even produce blisters on the skin, their effect when taken by mouth in the gastro intestinal tract is as follows:

1. They produce a sense of warmth and comfort in the stomach and relieve the feeling of distention after meals, as well as belching.

2. They increase the secretion of digestive juices and aid the appetite.

3. They check intestinal fermentation and putrefaction by their antiseptic properties, and they increase peristalsis, aiding in the expulsion of gas.

4. Some of the preparations are absorbed and then excreted through the lungs, when they increase expectoration; and by the urine when they slightly increase the flow of urine.

Uses

The carminatives are used principally to relieve the uncomfortable feeling due to the distention of the stomach with gas, and to relieve tympanites (abdominal distention) in infectious diseases. Some of the preparations are given together with some cathartics to lessen the griping pains, and as flavoring substances to disguise unpleasant tasting drugs. Many of the carminatives are spices and are used as condiments with food.

Poisonous Symptoms

Some of the carminatives are irritating in large doses and may then cause severe diarrhoea, painful urination, collapse and nervous twitchings. After recovery from these symptoms the patient may develop colitis (inflammation of the colon) and nephritis (inflammation of the kidney).

Preparations

The substances used as carminatives are vegetable substances containing volatile oils, spices and preparations of other drugs. Some of these preparations are used principally for the carminative effect.

Substances Used to Lessen Colic

Peppermint	{	The oil is given in doses of 0.3 c.c., m. v.
(<i>Mentha Piperita</i>)		The water is given in doses of 4.0 c.c., 3i.
		The spirit is given in doses of 0.6 c.c.-2.0 c.c., m. x-xxx.

This is given as peppermint water, peppermint tea or spirit of peppermint.

Ginger (Zingiber)

This is given in the essence or the tincture.

Spices

Allspice (Pimenta)

Cardamom

Fennel (Foeniculum)

The powder is given in doses of 1.0 Gm. (grs. xv).

This is given in the form of tea.

Cloves (Caryophyllus)

Nutmeg (Myristica)

The oil is given in doses of 0.3 c.c., (m. v).

Aromatic Powder
(Pulvis Aromaticus)

0.3-2.0 c.c.

grs. v-xxx

This contains cinnamon, cardamom, nutmeg and ginger in powder form. It is used principally to lessen the griping of cathartics.

Substances Used to Lessen Abdominal Distension (Tympanites)

The following preparations are used to relieve the abdominal distention and to cause the expulsion of gas in infectious diseases such as typhoid fever or pneumonia.

Asafoetida

This is a gum resin obtained from a plant which grows in India, where it is frequently used as a condiment. It is given in pills, each containing 0.2 Gm. (grs. iii) or in the tincture in doses of 1.0-2.0 c.c., m. xv-xxx. It is used principally to relieve distention and is frequently given as an enema.

Because of its unpleasant taste, which causes a psychical effect, it is occasionally given to quiet hysterical patients.

Oil of Turpentine

This is given in capsules each containing 0.6 c.c., m. x.

Preparations Used for Flavoring

Cinnamon Bark
(Cinnamomi Cortex)

The water and the spirit of this preparation are used.

Spearmint
(Mentha Viridis)

Wintergreen
(Gaultheria)

The oil and the spirit are used.

Lavender
(*Lavandula*)

Rose Water
(*Aqua Rosae*)

This is used principally in the form of rose water ointment.

Unguentum Aqua Rosae (Cold cream)

Bitter Almond
(*Amygdala Amara*)

If rubbed with other substances this may form prussic or hydrocyanic acid, a very poisonous substance.

Bitter Orange Peel
(*Aurantii Amari*)

Sweet Orange Peel
(*Aurantii Dulcis*)

Anise

This is obtained from wormwood plant. Absinthe is made when it is distilled. It is an ingredient of the Solution of ammonium and anise (*Liquor ammonii anisatus*), a commonly used cough medicine.

Aromatic Elixir
(*Elixir Aromaticum*)

This contains compound spirit of orange.

Elixir Adjuvans

This is aromatic elixir containing a little licorice.

Carminative Preparations of Other Drugs

Aromatic Spirit of Ammonia (<i>Spiritus Ammonii Aromatici</i>)	0.6-2.0 c.c.	m. x-xxx
Compound Spirit of Ether (Hoffman's Anodyne) <i>Spiritus Aetheris Compositus</i>	2.0-4.0 c.c.	$3\frac{1}{2}$ -i
Chloroform Water (<i>Aquae Chloroformi</i>)	0.06-1.0 c.c.	m.i-xv
Camphor Water (<i>Aquae Camphorae</i>)	4.0-10.0 c.c.	3 i-ii $\frac{1}{2}$
Camphor Spirits (<i>Spiritus Camphorae</i>)	0.3-2.0 c.c.	m. v-xxx

Alcoholic Carminatives

Cordials
Kümmel
Gin
Cherry Water (*Kirchwasser*)

EMETICS

Emetics are drugs which produce vomiting. They are now seldom used except in cases of poisoning, since the stomach can be readily washed out by means of a stomach tube. When emetics are indicated the following substances are used:

Mechanism of Vomiting

Vomiting is an act whereby the stomach violently expels its contents. In the act of vomiting the pylorus of the stomach is closed, otherwise only retching occurs. The act of vomiting is preceded and accompanied by a number of other symptoms such as excessive flow of saliva, secretion of tears, and a flow of mucus from the nose and bronchial tubes, pallor of the skin and exhaustion.

The strain of continued vomiting produces symptoms of collapse: The pulse becomes rapid and weak, the patient looks pale, and he feels weak and exhausted.

Drugs produce vomiting in two ways:

1. When they irritate the mucous lining of the stomach, the muscles of the stomach contract violently, thereby forcibly expelling its contents.
2. When a substance is absorbed, entering the blood stream, and then affecting a small area of gray matter in the medulla of the brain (the vomiting center), which co-ordinates the mechanism of vomiting. As a result of this action, vomiting is produced.

APOMORPHINE

Apomorphine is an artificial alkaloid made from morphine, one of the alkaloids of opium. An acid is added to the morphine to deprive it of water, thus forming apomorphine. This process is called dehydration.

ACTION

A moderate dose of apomorphine, when given hypodermically, produces, in five or ten minutes, intense nausea and profuse vomiting. This is accompanied by the usual associated symptoms such as the flow of tears, the secretion of mucus, the pallor and the exhaustion. The collapse which usually accompanies vomiting is very rarely fatal.

When given in very small doses, no vomiting is produced but all the secretions such as the mucus in the bronchial tubes, and the secretion of other mucous membranes, are increased. It is occasionally given in cough medicines for this purpose to increase the expectoration.

Preparations

Apomorphine Hydrochloride as emetic 0.006-0.012 Gm. gr. $\frac{1}{10}$ - $\frac{1}{5}$

(Apomorphinae Hydrochloridum) as expectorant 0.002-0.004 Gm. gr. $\frac{1}{30}$ - $\frac{1}{15}$

To produce vomiting it is usually given hypodermically.

→ IPECAC

This is used principally as an expectorant, but it is occasionally given in the following preparations and doses to produce vomiting (see page 247).

Preparations

→ Powdered Ipecac (Pulvis Ipecacuanhae)	2.0 Gms.	grs. xxx
Wine of Ipecac (Vinum Ipecacuanhae)	for a child 2.0 -4.0 c.c.	$3\frac{1}{2}$ -i

OTHER EMETICS

→ Mustard

This is given in tepid water; a teaspoonful to a tablespoonful repeated every fifteen minutes.

→ Warm Water

Lukewarm water given repeatedly will also produce vomiting.

→ Sodium Chloride (Salt)

Sodium Chloride is given in solid form or in concentrated solutions.

Copper Sulphate	1.0-2.0 Gms.	grs. xv-xxx
Zinc Sulphate	0.6-1.0 Gm.	grs. x-xv
Alum	1.0-2.0 Gms.	grs. xv-xxx
Wine of Antimony	0.6-2.0 c.c.	m. x-xxx
Tartar Emetic	0.03-0.12 Gm	grs. $\frac{1}{2}$ -ii
Turpeth Mineral (Yellow Mercurous Subsulphate)	0.06-0.3 Gm.	grs. i-v

CHAPTER XIII

CATHARTICS

(Intestinal Stimulants)

Cathartics are drugs used to move the bowels. Many drugs which produce effects on various organs of the body, may also increase the movements of the bowels, but the drugs here considered, are those which are used principally for this effect.

Mode of Action

Movements of the bowels are brought about by the contractions of the involuntary muscles of the intestines (peristalsis). This is caused in the following ways:

1. When the intestines fill up with solid, fluid or gaseous matter. This causes contractions of the intestinal muscles, producing movements of the bowels.

2. When drugs irritate the mucous membrane of the intestines. This not only causes an increased secretion of mucus, which helps to fill up the intestines, but it also affects the nerve endings in the wall of the intestines. Impulses are thus sent along the afferent nerve fibers to the spinal cord, which immediately sends back other impulses to the intestinal muscles to cause them to contract, and movements of the bowels result. (Such an action is called a reflex action.)

Frequent movements of the bowels are often accompanied by violent cramp-like pains in the abdomen (gripping), due to contractions of the involuntary muscles of the intestines which accompany such movements.

To overcome the gripping, many cathartics are often combined with other drugs which lessen intestinal peristalsis. For example, lapactic pills are very efficient commonly used cathartics. They contain the extract of belladonna to overcome the gripping which they might otherwise produce.

3. Many cathartics, such as the salines, draw fluid into the intestines from the blood and tissues; thereby filling up the intestines with fluid, which is expelled by the resulting contractions of the intestinal muscles. In this way, fluid is removed from the blood and tissues so that oedema (fluid in the tissues) may be lessened and the blood pressure reduced.

Classification

Cathartics may cause mild, moderate, or severe action; and are accordingly divided into the following three groups:

1. **Laxatives**
2. **Purgatives (Mercurial, Vegetable and Saline)**
3. **Drastic Purgatives.**

All the cathartics cannot be arranged into such well-defined groups since the effect often depends on the dose. Some cathartics produce mild effects in small doses, and greater, even violent, effects in larger doses. The classification here given however, is according to the effects produced by the doses usually administered, and is the most practical one for the nurse, who has to report effects of remedies.

Cathartics may also be classified according to the part of the intestine they affect: the entire intestine, the duodenum, the small intestine or the large intestine. Another classification consists in grouping cathartics according to their active principles.

LAXATIVES

Laxatives are medicines which cause a few movements of the bowels. The stools are formed, normal in character, and the movements are not accompanied by griping. The most commonly used laxative drugs are the following substances:

Mineral Oil

Agar Agar

Sulphur

Olive Oil

Ox Gall

Cascara

Phenolphthalein and similar substances.

Many foods which leave a great deal of residue or undigested material, act as laxatives. Such foods as oatmeal, wheat, bran and many fruits are distinctly laxative. These may be given as night slightly flavored with sugar. Large quantities of water is also a good laxative.

LIQUID PETROLATUM (MINERAL OIL)

Liquid petrolatum, mineral oil or liquid paraffin is a heavy oily substance which is obtained from petroleum oil. Chemically, it belongs to the group of hydrocarbons. It is on the market under various names: Liquid Vaseline, Liquid Albolene, etc. Russian mineral oil is the same substance obtained from Russia, but is much heavier than the American product.

Action

Applied locally, mineral oil is bland and soothing to the skin and mucous membranes.

When taken internally, it is not absorbed. When it enters the intestine it becomes mixed with the intestinal contents which it protects from the action of the digestive juices. The water of the intestinal contents is therefore not absorbed and the mass of faeces gradually becomes increased. This distends the intestines and bowel movements result. At the same time mineral oil lubricates the mucous membrane of the intestines.

Mineral oil is used as a laxative especially in chronic constipation; which is frequently due to a weakened condition of the intestinal muscles or to delicate kinks or adhesions of the intestines. It occasionally causes nausea and it frequently has a tendency to ooze from the rectum between stools.

It is given in doses of 15.0–30.0 Gms. (℥ss–i), two or three times a day.

Administration

Liquid petrolatum or mineral oil should be given about two or three hours after meals, undiluted. As it has a bland taste, which patients usually do not like, it should be flavored with some aromatic substance such as peppermint or cinnamon water.

AGAR AGAR

Agar agar is a fibrous substance made from various seaweeds of the East Indies.

Action

Agar agar is used principally as a laxative. It withdraws fluid from the stomach and intestines, forming a large jelly-like mass, which is indigestible, and increases the bulk of the fecal masses, so that the intestines become distended.

The distention of the intestines produces frequent strong contractions of its muscle wall (peristalsis), which result in frequent movements of the bowels.

Agar agar is given in milk, or is eaten with oatmeal gruel or other cereals.

Preparations

Agar Agar	4.0–15.0 Gms.	℥i–℥½
Agar Agar with Calumba		
Agar Agar with Gentian		
Agar Agar with Phenolphthalein		

Regulin is a preparation of agar agar with cascara, and is given in the same doses. It is eaten with cereal.

Agarol is a preparation of agar agar and mineral oil.

CASCARA

Cascara sagrada is obtained from the bark of the **California buckthorn**. Its official name is **Rhamnus Purshiana**. It acts on the large intestine and is one of the best laxatives. It is usually given at night, and produces a normal stool the next morning, without griping. It is often given for habitual constipation.

Preparations

Extract of Cascara Sagrada (<i>Extractum Rhamni Purshianae</i>)	0.25 Gm.	grs. iv
Fluidextract of Cascara Sagrada (<i>Fluidextractum Rhamni Purshianae</i>)	1.0-4.0 c.c.	mxv-3i
Aromatic Fluidextract of Cascara Sagrada (<i>Fluidextractum Rhamni Purshianae Aromaticum</i>)	1.0-4.0 c.c.	mxv-3i

This contains cascara, licorice, magnesia, 25% of glycerin and compound spirit of orange.

OLIVE OIL

Olive oil is a food substance which is used as a mild laxative. When given in large amounts, it is not absorbed and increases the bulk of the stool, thereby increasing bowel movements. It is also used to lessen the excessive acid in the stomach and to dissolve gallstones, ineffectively, however. It is given in enemas to soften the stool.

SULPHUR

Sulphur or brimstone is an inorganic element. It acts as a laxative by increasing the bulk of the stool and softening it. Sulphides and sulphates are formed in the intestines, which also increase peristalsis.

Preparations

Sublimed Sulphur, or Flowers of Sulphur (<i>Sulphur Sublimatum</i>)	4.0-15.0 Gms.	3i-iv
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This is the most commonly used preparation. It is frequently combined with molasses and cream of tartar (potassium bitartrate) as a popular Spring medicine.

Precipitated sulphur is used principally in solutions for skin diseases, and washed sulphur is used in 15% solution in the preparation of sulphur ointment. Sulphur is best given in syrup.

PHENOLPHTHALEIN

Phenolphthalein is a chemical substance which is used in the laboratory to test the reaction of various substances, since it turns red when an alkali is added to it.

Phenolphthalein acts as a very good laxative, producing frequent soft stools with little griping. It increases peristalsis and prevents absorption of fluids, thus causing bowel movements. It increases the flow of bile.

Phenolphthalein	0.1-0.2 Gm.	grs. $i\frac{1}{2}$ -iii
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Phenoltetrachlorphthalein	0.4 Gm.	grs. vi
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This is injected intramuscularly in 20 c.c. of olive oil as a test for liver function since it is excreted in the bile. It also acts as a laxative.

FEL BOVIS (OX GALL)

Fel bovis is dried bile, obtained from the ox. It is used as a mild laxative and to increase the flow of bile. It is given together with other cathartics. The active principles of bile are the bile salts, sodium glycocholate and sodium taurocholate.

Preparations

Purified Ox gall (Fel Bovis Purificatum)	0.3-1.2 Gms.	grs. v-xx
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Bilein	0.005-0.015 Gm.	gr. $\frac{1}{12}$ - $\frac{1}{4}$
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This is sodium glycotaurocholate. It is a mixture of bile salts.

Bile Salts	0.12-0.4 Gm.	grs. ii-vi
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This is prepared from fresh ox gall and contains bile salts.

Glycotauro	0.15 Gm.	grs. $ii\frac{1}{2}$
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This is concentrated ox gall containing 50% of sodium glycocholate and sodium taurocholate. It is given in keratin coated pills.

Ovogal	0.5-1.0 Gm.	grs. viii-xv
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This is a combination of the acids obtained from bile salts, combined with egg albumin.

Other Laxatives

Psyllium Seeds

Flaxseed

These are seeds which swell up in the intestines and increase the size of the stool. They are given in doses of 4.0 Gms. (3i), or together with cereals.

Glycerin

This is used principally in the form of suppositories or it is added to enemas.

Molasses (Syrupus Fuscus)

Manna

This is a drug obtained from the sap of the European ash tree which grows chiefly in Sicily and Calabria. It contains a sugar, mannite. It is given in doses of 15.0-60.0 Gms. ($\mathfrak{z}\frac{1}{2}$ -3ii). It is used as a mild laxative, very often combined with other purgatives.

Tamarind

Tamarindus or tamarind is the preserved fruit of the *Tamarindus indica*, a tree growing in the East or West Indies. It is eaten like preserves, and is a very good laxative.

Frangula

This is obtained from the bark of the European buckthorn or *Rhamnus frangula*. It is used as a laxative. The fluid extract is given in doses of 1.0-2.0 c. c. (m xv-xxx.)

PURGATIVES

Purgatives are drugs which produce frequent movements of the bowels, with soft stools accompanied by griping.

There are three kinds of purgatives: **Mercurial, Vegetable, and Saline.**

1. **Mercurial purgatives** are preparations of mercury used as purgatives.

2. **Vegetable purgatives** are plant or other substances which cause frequent movements of the bowels.

2. **Saline purgatives** are inorganic (mineral) salts used as purgatives. These are often called **hydragogue cathartics**, because they produce very frequent watery stools.

Many purgatives are also called **cholagogue cathartics** because the stools resulting from their use are highly colored with bile. This is due to the fact that they act mainly on the duodenum or first part of the small intestine, and, therefore, also bring about contractions of the bile ducts, which pour more bile into the intestine. They do not increase the secretion of bile.

Large doses of the laxatives act as purgatives. The substances used principally as purgatives are the following:

Calomel and other mercurial preparations

Podophyllum

Castor oil

Rhubarb

Aloes

Senna

Licorice

and various combinations of these substances.

MERCURIAL PURGATIVES**CALOMEL**

Calomel is a compound of mercury; **hydrargyri chloridum mite** or the mild mercurous chloride. It is used principally as a

purgative. It produces frequent soft stools, very highly colored with bile, and it is often called, therefore, a cholagogue cathartic.

It acts principally on the duodenum, the first part of the small intestine and the entire small intestine. It irritates the mucous membrane of the intestine, which brings about contractions of its muscle wall (peristalsis). It also induces contractions of the bile ducts, which are closely attached to the duodenum or first part of the small intestine. The flow of bile into the intestine is then increased and the stools contain a great deal of bile. Calomel also acts as an antiseptic in the intestines, checking the growth of bacteria. It has a decided tendency to produce griping. It is also used to increase the flow of urine (diuretic action).

Administration

Calomel may be given in a single dose or in small doses, frequently repeated; for example, gr. $\frac{1}{4}$ every fifteen minutes until two grains are taken. It is often given with sodium bicarbonate; about grs. v of sodium bicarbonate with every gr. $\frac{1}{2}$ of calomel, to lessen the griping.

Calomel should be given between meals or at night. It should always be followed by a dose of one of the saline cathartics, to prevent absorption; which may cause symptoms of poisoning: a metallic taste in the mouth, abdominal pain, vomiting, diarrhoea and excessive flow of saliva.

Milk, eggs and other albuminous food should not be given shortly after calomel.

Preparations

Calomel	0.008-0.3 Gm.	gr. $\frac{1}{8}$ -v
(Hydrargyri Chloridum Mite)		

Other Mercurial Preparations

Blue Mass	0.06-0.3 Gm.	grs. i-v
(Massa Hydrargyri)		

This compound of mercury is a milder purgative than calomel. It is always given in pill form, each pill containing about grs. iii-v of blue mass.

Mercury with Chalk (Gray Powder)	0.12-0.5 Gm.	grs. ii-viii
Hydrargyrum cum Creta		

This preparation is made of metallic mercury, with chalk and honey. It is always prescribed in powder form. It is milder than calomel. The chalk lessens the griping.

VEGETABLE PURGATIVES

CASTOR OIL—(OLEUM RICINI)

Castor oil is a fixed oil (an oil which does not evaporate), obtained from the seeds of the *Ricinus communis*, a tree growing in all warm countries. The seeds are warmed, and the oil is then pressed out of them. The oil ordinarily used is obtained from Calcutta in India.

Castor oil has no odor, but a very unpleasant nauseating taste.

The active principle of castor oil is **ricinoleic acid**, and its compounds **ricinoleates**. Old castor oil contains more ricinoleic acid, and is therefore often more efficacious.

Action

Castor oil acts principally on the intestines as a purgative. It produces frequent movements of the bowels in about three to six hours, not accompanied by griping. The stools are soft, but after the movements have occurred, the bowels are apt to be constipated.

Castor oil is decomposed by the intestinal juices, forming ricinoleic acid. This combines with the alkaline intestinal juices forming ricinoleates, which produces intestinal peristalsis causing bowel movements. Castor oil is excreted by all the secretions. Because it is eliminated in the milk, castor oil often acts as a laxative on nursing infants.

Castor oil is one of the best cathartics for temporary use; because of its soothing after effect which checks further bowel movements.

Administration

In giving castor oil the unpleasant taste must be disguised. To some people, however, the taste is not at all unpleasant. For example, the Chinese are very fond of castor oil and do not mind its taste, in fact, they use it as a food.

Castor oil should always be given cold, as the taste is then not as readily appreciated. The object of disguising the taste is to coat the oil with a substance which will make it taste more pleasant. This may be done in the following ways:

1. By giving the oil in an equal part of glycerin or brandy.
2. By making an emulsion of the oil by pouring it into flavored soda water, sarsaparilla or grape juice.
3. The patient's mouth may be rinsed out with a little whiskey or peppermint, before giving the castor oil.
4. It may be given with sodium bicarbonate.

5. It may be poured between two layers of lemon juice, grape juice, orange juice, or whiskey, as in the following method:

Castor Oil Cocktail

Rinse out the medicine glass with some whiskey or lemon juice, and pour about a teaspoonful of lemon juice in the bottom of the glass. The castor oil is then added; and on top of that, a teaspoonful of whiskey, raspberry juice, lemon juice, grape juice, or peppermint. The mixture is then administered.

A little vichy or seltzer, or an olive, will often remove the unpleasant nauseous feeling which follows the taking of a dose of castor oil, even when its taste is disguised.

Preparations

Castor Oil	15.0–30.0 c.c.	$5\frac{1}{2}$ -i
(Oleum Ricini)	For an infant 4.0–8.0 c.c.,	3i-ii

Laxol: This is a tasteless preparation of castor oil.

Castor oil is also put up in flexible capsules, to disguise its unpleasant taste.

(The castor oil bean is never used because it contains a very poisonous substance, ricin.)

PODOPHYLLUM

Podophyllum is the underground root and rootlets of the **Podophyllum peltatum**, the May apple or mandrake, a perennial plant growing in Northern and Middle United States. Its active principle is a resin, **podophyllin**.

Podophyllum causes frequent copious bile-stained stools about eight to twelve hours after it is given.

Resin of Podophyllum	0.015–0.06 Gm.	gr. $\frac{1}{4}$ -i
(Resina Podophylli)		

RHUBARB

Rhubarb is obtained from the root of the **Rheum officinale**, a plant growing in China and Tartary. The plant is similar to the ordinary rhubarb, but is much larger.

Action

Rhubarb acts principally upon the large intestine as a purgative, producing frequent fluid stools, not accompanied by griping. On account of the tannic acid which it contains, rhubarb constipates after its purgative action.

The urine, and in nursing women, the milk, is sometimes colored yellow when rhubarb is taken.

Preparations

Extract of Rhubarb (<i>Extractum Rhei</i>)	0.3-0.6 Gm.	grs. v-x
Compound Rhubarb Pill (<i>Pilula Rhei Composita</i>)	1-5 pills	
(This contains aloes, myrrh, oil of peppermint and rhubarb.)		
Compound Rhubarb Powder (<i>Pulvis Rhei Compositus</i>) (Gregory's powder)	1.0-4.0 Gms.	grs. xv-3i
(This contains magnesia, ginger and rhubarb.)		
Aromatic Syrup of Rhubarb (<i>Syrupus Rhei Aromaticus</i>)	2.0-8.0 c.c.	3ss-ii for a child.
Rhubarb and Soda Mixture (<i>Mistura Rhei et Sodae</i>)	8.0 c.c.	3ii

This contains rhubarb, ipecac, sodium bicarbonate, spirit of peppermint and glycerin.

ALOES

Aloes is the dried juice of several species of **Aloes**, a plant growing in the Barbadoes, and other islands in the Indian Ocean, and in Arabia. It is one of the oldest drugs in medicine. It was used in the time of Alexander the Great, about 300 B. C.

The preparations are made up from **Aloes**, which is obtained from the Barbadoes Islands, and the Island of Socotra. The active principle is **aloin**, which belongs to a group of substances known as the anthracene group because they are all similar to anthracene, a substance obtained from coal tar.

Action: Aloes acts principally on the large intestine, causing irritation, which produces frequent movements of the bowels. In nursing women it is eliminated in the milk and may act as a purgative on the infant.

Aloes is seldom administered alone. It is usually given together with other purgatives.

Preparations

Solid Preparations

Pill of Aloes (<i>Pilulae Aloes</i>)	1-5 pills
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Each pill contains 0.12 Gm. (grs. ii) of aloes

Pills of Aloes and Iron (<i>Pilulae Aloes et Ferri</i>)	1-5 pills
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Each pill contains 0.12 Gm. (grs ii) of aloes.

Pills of Aloes and Mastiches (Lady Webster's dinner pill.) 1-5 pills
(*Pilulae Aloes et Mastiches*)

Each pill contains grs. ii of aloes.

Pills of Aloes and Myrrh (Rufus' pill.) 1-5 pills
(*Pilulae Aloes et Myrrhae*)

Each pill contains 0.12 Gm., grs. ii of aloes.

Aloin (the active principle) 0.015 Gm. gr. $\frac{1}{4}$
(*Aloinum*)

Lapactic Pills or A. B. & S. pills dose, 2 pills
(*Pilulae Laxativae Compositae*)

Each pills contains

Aloin	gr $\frac{1}{4}$
Extract of Belladonna	gr. $\frac{1}{8}$
Strychnine	gr. $\frac{1}{120}$
Powdered Ipecac	gr. $\frac{1}{15}$

Alophen Pills

This is a proprietary modification of the A. B. & S. pill containing aloin gr. $\frac{1}{4}$, extract of belladonna gr. $\frac{1}{12}$, strychnine gr. $\frac{1}{80}$, ipecac, gr. $\frac{1}{15}$ and phenolphthalein gr. $\frac{1}{2}$.

Fluid Preparations

Tincture of Aloes 2.0-8.0 c.c. 3ss-1i
(*Tinctura Aloes*)

Aloes is also contained in the compound rhubarb pill, compound extract of colocynth, and compound tincture of benzoin.

SENNA

Senna is obtained from small dried leaves of an oriental shrub.

There are two kinds of senna plants: *Cassia acutifolia*, which comes from Alexandria in Egypt, and *Cassia angustifolia*, from India. The active principle of senna belongs to the same group of substances (anthracene derivatives) as aloin.

Action: Senna acts principally on the large intestine, producing in about five hours, frequent watery stools, usually accompanied by severe griping pains. To overcome the griping, it is usually combined with other substances, especially carminatives.

It is excreted in the urine. In nursing women it is excreted in the milk, and it will then act as a laxative on the nursing infant.

Senna in small doses is often given to children as a laxative.

Preparations

Confection of Senna 4.0-8.0 c.c. 3i-ii
(*Confectio Sennae*)

This contains senna, cassia fistula, tamarind, prune, fig, sugar and oil of coriander.

Compound Infusion of Senna (Black Draught)

(Infusum Sennae Compositum) 30.0-120.0 c.c. ℥i-iv

This contains senna, manna, magnesium sulphate and fennel.

Syrup of Senna 4.0-16.0 c.c. ℥i-iv
(Syrupus Sennae)

Compound Syrup of Sarsaparilla 15.0-30.0 c.c. ℥ss-i
(Syrupus Sarsaparillae Compositus)

This contains senna, licorice, sarsaparilla and aromatic substances.

Senna tea is a preparation often given to children. It is an infusion of senna leaves, made from a teaspoonful of leaves to a cup of water.

GLYCYRRHIZA (LICORICE ROOT)

Licorice is the root of *Glycyrrhiza glabra*, an English plant. Its active principle is a glucoside, *glycyrrhizin*.

Action: Applied to the skin it is soothing and protecting (demulcent). Taken internally, it is a mild purgative, producing frequent fluid stools without griping, in about ten to fifteen hours; or in three to six hours, when given on an empty stomach.

It is especially valuable in patients suffering from haemorrhoids. The fluid stools resulting from licorice powder lessen the pain produced by movements of the bowels in cases of haemorrhoids. It is best given at bedtime.

Compound Licorice Powder 4.0 Gms. ℥i
(Pulvis Glycyrrhizae Compositus)

This contains senna, licorice root, sulphur, fennel and sugar. It should be given in very little water, as it may cause nausea, but it should always be followed by a drink of water.

PURGATIVES GIVEN HYPODERMICALLY

Eserine or Physostigmine

This is frequently given hypodermically to move the bowels and relieve distention, especially after operations. It acts by increasing the peristalsis of the intestinal muscle. It may cause collapse. (See page 338.)

Pituitrin

This is given hypodermically to expel gas and relieve tympanities. (See page 396.)

SALINE PURGATIVES

Saline purgatives are inorganic (mineral) salts used as purgatives. Only those salts are used which are not readily absorbed. All the saline purgatives act on the entire intestine.

Action

In the mouth: Most of the saline purgatives have a harsh, unpleasant, bitter taste.

In the stomach: They often produce nausea and vomiting.

In the intestines: They produce frequent fluid stools accompanied by griping.

Mode of Action

When given in small doses, or in dilute solutions, so that the percentage of salt in the intestine is less than that in the blood (anistonic), or equal to that in the blood (isotonic), the salts are not absorbed, but they prevent the passage of fluids through the lining membrane of the stomach and intestines (absorption). This fluid then distends the intestines, especially the large intestine, causing contractions of the muscle wall with resulting fluid stools.

When given in larger doses, or in concentrated solutions, so as to make the percentage of salt in the intestines greater than that in the blood (hypertonic), the salts are also not absorbed. They withdraw fluid into the intestines from the blood and tissues until the salt in the intestines becomes diluted sufficiently; that is, until it contains the same percentage of salt as the blood (isotonic). The passage of fluid from a weaker to a stronger solution is called osmosis. This process continues until the quantity of fluid in the intestines has increased to such an extent that the intestines, especially the large intestine, become distended and frequent fluid stools result.

A small portion of each dose of some of the salines is absorbed, and acts on the kidneys as a diuretic, increasing the flow of urine.

Uses

The saline cathartics are used as active purgatives and to reduce the accumulation of fluid in the tissues, which is called oedema. For example, to reduce oedema of the legs in nephritis, or to reduce ascites (fluid in the abdomen). In such cases they withdraw the fluid from the tissues into the intestines. The bowels then become distended with fluid which produces frequent fluid movements and the oedema or the ascites is gradually relieved.

Saline cathartics are also given to reduce blood pressure, because they withdraw fluid from the blood. By lessening the total quantity of blood in the body, blood pressure is reduced.

The saline cathartics should not be given in cases where there are ulcers or inflammation in the intestines, as they may aggravate this condition.

Administration

The saline cathartics are best given well diluted, preferably in the morning, when the stomach is empty. They move the bowels in a few hours.

To relieve oedema, they should be given in a concentrated solution, since more fluid is thus removed, and the effect is more prolonged.

The preparations of the saline purgatives are best given in cold seltzer or vichy. If they are given hot, the addition of 10 or 15 drops of tincture of ginger makes them taste more agreeable. They should not be given stronger than 5-10% solutions.

Preparations

SODIUM SALTS

Sodium Sulphate (Glauber's Salt)	2.0-30.0 Gms.	3½-3i
(Sodii Sulphas)		

This is soluble in 3 parts of water. It is best given in solution, in vichy or seltzer, not stronger than 5-10% solutions.

Sodium Phosphate	1.0-30.0 Gms.	grs. xv-3i
(Sodii Phosphas)		

This is soluble in 6 parts of water.

It is best given in milk, not stronger than 5-10% solutions.

POTASSIUM SALTS

Potassium Sulphate	1.0-4.0 Gms.	grs. xv-3i
(Potassii Sulphas)		

Potassium Bitartrate (Cream of tartar)		
(Potassii Bitartaras)	1.0-4.0 Gms.	grs. xv-3i

Potassium and Sodium Tartarate (Rochelle Salt)		
(Potassii et Sodii Tartaras)	8.0-16.0 Gms.	3ii-iv

This is soluble in 1½ parts of water. It tastes pleasanter than Epsom salt.

MAGNESIUM SALTS

Magnesia Oxide, Calcined Magnesia, Light Magnesia or Magnesia Usta		
(Magnesii Oxidum)	2.0-4.0 Gms.	grs. xxx-3i

Magnesia is very mild in action.

Magnesium Sulphate (Epsom salt)		
(Magnesii Sulphas)	2.0-30.0 Gms.	3½-3i

This is soluble in $1\frac{1}{2}$ parts of water.

Magnesium sulphate is very commonly used. It has a very unpleasant taste and is best given in seltzer or vichy.

Large doses produce very frequent stools, with a good deal of griping. The preparations of magnesia are best given in powder form, sweetened to disguise the taste.

MIXTURES OF VARIOUS SALTS

Carlsbad Salt (Sal Carolinum)

This is a mixture of the mineral salts obtained by evaporating the water of the Carlsbad mineral spring in Bohemia.

Artificial Carlsbad Salt (Sal Carolinum Factitium)

This is a mixture of the salts contained in natural Carlsbad water, and consists of the following salts:

Dried Sodium Sulphate	44 parts
Potassium Sulphate	2 "
Sodium Chloride	18 "
Sodium Bicarbonate	36 "

Artificial carlsbad water contains about 70 Gms. of this salt to 1000 c. c. of water.

EFFERVESCENT PREPARATIONS

The following preparations of the salts form gas (effervesce), when dissolved in water.

Seidlitz Powder or Compound Effervescing Powder (Pulvis Effervescens Compositus)

This is made up in two powders:

1. The powder wrapped up in blue paper contains:

Sodium Bicarbonate	3.0 Gms.	grs. xl
Potassium and Sodium Tartarate (Rochelle Salts)	9.0 Gms.	3 ii

2. The powder wrapped up in white paper contains:

Tartaric Acid	2.0-2.4 Gms.	grs. xxx-xl
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A seidlitz powder should always be administered at the bedside. Each powder should be dissolved in half a glass of water, the two solutions mixed and the mixture given to the patient.

The combination of the tartaric acid and sodium bicarbonate forms carbon dioxide gas, which causes the effervescence. Seidlitz powder is often given to distend the stomach, for diagnostic purposes.

Solution of Citrate of Magnesia (Liquor Magnesii Citratis)

dose 150.0-360.0 c.c.

3 v-xii

This is a solution of magnesium citrate and citric acid, to which potassium bicarbonate is added. It is usually kept in tightly closed bottles, and effervesces when it is poured into a glass.

Effervescent Magnesium Sulphate (Magnesii Sulphas Effervescens)

15.0-30.0 Gms.

3 $\frac{1}{2}$ -i

This contains epsom salt, sodium bicarbonate, tartaric and citric acids. The mixture effervesces when mixed with water.

Effervescent Sodium Phosphate (<i>Sodii Phosphas Effervescens</i>)	8.0-15.0 Gms.	3 ii-3 ½
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This contains sodium phosphate, sodium bicarbonate, tartaric and citric acids. The mixture effervesces when dissolved in water.

Effervescent Lithium Citrate (<i>Lithii Citras Effervescens</i>)	4.0-8.0 Gms.	3 i-ii
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This contains lithium citrate or lithium carbonate, sodium bicarbonate and citric acid.

All the effervescent preparations, if not already in solution, should be given in a tumblerful of water.

NATURAL PURGATIVE WATERS

Many natural mineral waters are used as cathartics. They contain very small quantities of salts in their natural state, but when they are bottled various saline purgatives are added. The following are the preparations commonly used:

Carlsbad Water

This contains magnesium and sodium sulphate, and other salts.

Apenta Water

This consists mainly of sodium and magnesium sulphate with small quantities of sodium chloride and sodium bicarbonate.

Pluto Water

This is obtained from the French Lick Springs in Indiana, and consists mainly of sodium and magnesium sulphates with small quantities of sodium chloride, calcium, magnesium and iron salts.

DRASTIC PURGATIVES

Drastic cathartics are drugs which cause frequent fluid movements of the bowels, accompanied by severe griping pains.

The substances principally used as drastic purgatives are the following:

Croton oil

Jalap

Elaterine

Colocynth

Gamboge

Scammony

and various compounds of these substances.

Action

The drugs used as drastic cathartics act principally on the small intestine. They increase the secretions of the intestinal

mucous membrane and the contractions of the intestinal muscles, thus causing frequent copious fluid stools accompanied by griping. The drastic purgatives withdraw fluid from the tissues into the intestines, and thus tend to relieve oedema and ascites. The copious fluid stools frequently cause severe collapse. Drastic purgatives should therefore not be given to very young or to very old patients. In pregnant women they may induce abortion. When several drastic cathartics are given together they are not so apt to cause such violent action as when given alone.

Poisonous Effects

In large doses, most of the drastic purgatives are violent poisons; producing nausea, vomiting, abdominal pain and profuse diarrhoea. The stools contain blood and flakes of the lining membrane of the intestines, which is usually very severely irritated by large doses.

If the diarrhoea is severe and prolonged it is followed by severe collapse: the skin is pale, moist and cold, the breathing is slow and shallow, the pulse is rapid, thready and weak, the pupils are widely dilated, and the patient finally goes into coma and may die.

CROTON OIL (OLEUM TIGLI)

Croton oil is a fixed oil (an oil which does not evaporate), pressed out from the seeds of the **Croton tiglium**, a shrub growing in Hindostan and other parts of Southern Asia. Its active principle is an acid, **crotonoleic acid**.

Action: Croton oil acts principally on the small intestine; producing, in one or two hours after it is given, frequent large fluid stools with severe griping pains. The violent movements of the bowels continue for about twelve to fifteen hours, and each stool is accompanied by severe griping, so that the patient soon becomes exhausted.

Mode of Action: Croton oil acts like castor oil. Crotonoleic acid is formed by the digestive juices, which causes the bowel movements. Some of the crotonoleic acid is absorbed into the blood, and is excreted by all the secretions.

Administration

Croton oil is given principally to patients who are unable or unwilling to swallow medicine. It is given in cases of apoplexy, for instance, when the patient is unconscious; or in an attack of mania, when the patient is so excited, that he refuses to swallow medicine.

juice, which is the gum resin, is caught from the broken twigs in vessels and dried.

Gamboge is one of the most violent drastic purgatives and may cause very severe collapse.

Gamboge	0.1-0.6 Gm.	gr. $1\frac{1}{2}$ -x
(Gambogia)		

SCAMMONY (SCAMMONIUM)

Scammony is the dried milky juice (resin), obtained from the root of the *Convolvulus scammonia*, a vine growing in Syria. Its active principle is jalapin, a resinous substance.

Scammony is used principally as a drastic cathartic.

Resin of Scammony	0.2-0.5 Gm.	grs. iii-viii
(Resina Scammoniae)		

Compound Preparations of Drastic Purgatives

Compound Cathartic Pills or Compound Pills of Mild Mercurous Chloride
(Pilulae Catharticae Compositae or Pilulae Hydrargyri Chloridi Mitis Compositae)

This is very frequently used. Each pill consists of:

Compound Extract of Colocynth	0.08 Gm.	gr. $1\frac{1}{3}$
Calomel	0.06 Gm.	gr. i
Resin of Jalap	0.02 Gm.	gr. $\frac{1}{3}$
Gamboge	0.015 Gm.	gr. $\frac{1}{4}$

1 pill is given for a purgative, 3 pills for a drastic effect.

Vegetable Cathartic Pills

(Pilulae Catharticae Vegetabiles)

Compound Extract of Colocynth	0.06 Gm.	gr. i
Extract of Hyoscyamus	0.03 Gm.	gr. $\frac{1}{2}$
Resin of Jalap	0.02 Gm.	gr. $\frac{1}{3}$
Extract of Leptandra	0.015 Gm.	gr. $\frac{1}{4}$
Resin of Podophyllum	0.015 Gm.	gr. $\frac{1}{4}$

and about m. i of oil of peppermint for every hundred pills.

The peppermint and the hyoscyamus lessen the griping.

ENEMATA

Enemata are fluids which are injected into the rectum. They are of two kinds: cathartic and nutritive.

Cathartic Enemata

Cathartic enemata are given to move the bowels. They usually act by distending the large intestine, which starts peristalsis. The contents of the intestines are expelled and frequent movements of the bowels result.

The following substances are commonly used in enemata:

Plain Water

Salt Solution

Soap Suds
Olive Oil
and various cathartics.

An excellent combination of cathartics which is given as an enema consists of:

Glycerin	120.0 Gms.	℥iv
Magnesium Sulphate	120.0 Gms.	℥iv
Ox gall	8.0 Gms.	℥ii
Turpentine	8.0 Gms.	℥ii

The turpentine is particularly valuable because it helps to expel gas. Another good combination consists of milk and molasses, which is especially efficient. The sugar and milk form gas which distends the intestine, causing frequent copious movements of the bowels. Starch is frequently added to lessen the irritation of the rectum.

Nutritive Enemata

Nutritive enemata are usually given to nourish the patient, when food cannot be taken by the mouth. They usually consist of milk, eggs, various meat juices, broths, or specially prepared substances. The foods used in nutritive enemata should be completely peptonized. They should be given very slowly, preferably by the **Rectoclysis** or **Murphy Method**.

ABSORBENT

CHARCOAL (CARBO LIGNI)

Charcoal is made from wood or bones. It readily absorbs gases and is therefore used to remove gas from the intestines.

It is best given in capsules, since it soon loses its efficiency when dissolved in a fluid.

Administration of Cathartics

Cathartics which produce mild effects, or which produce their effects slowly, should be given at night. Those which produce rapid effects, should be given in the morning.

Cathartics should never be given after meals as they may cause vomiting.

Cathartics which cause violent action should not be given in cases where the intestine is diseased.

For example: In **typhoid fever** or **acute appendicitis** violent cathartics should be avoided. In typhoid fever an active cathartic may increase the inflammation in the ulcers which are present in the intestinal mucous membrane in this disease. The

violent contractions which result from such a cathartic may increase the tendency to haemorrhage and perforation.

In cases of **acute appendicitis** the appendix may be very friable, and the violent contractions which result from many cathartics may cause rupture of the appendix.

In the after care of an abdominal operation, the nurse should never administer a cathartic without the doctor's order.

When the operation has been performed upon the stomach or intestines, the greatest care must be exercised in giving cathartics. In such cases no cathartic is usually administered before the third day after the operation, because the violent intestinal contractions may tear the delicate stitches in the wall of the intestines, and cause perforations with resulting peritonitis, that may be fatal. For example, after operations for the removal of the vermiform appendix, or for the removal of a part of the stomach or intestines or the suturing (sewing) of any of these organs.

SUMMARY OF PRINCIPAL CATHARTICS

Cathartics Arranged According to Site and Rapidity of Action

Group	Acting on Duodenum	Rapidity of Action	Acting on Small Intestine	Rapidity of Action	Acting on Large Intestine	Rapidity of Action	Acting on Entire Intestine	Rapidity of Action
Laxatives	Phenolphthalein	Hrs. 8-12	Olive Oil	Hrs. 8-12	Cascara Agar Agar	Hrs. 8-12 8-12	Mineral Oil	Hrs. 8-12
Purgatives	Calomel	2-8	Castor Oil	2-8	Rhubarb	8-12	Licorice Powder	8-12
	Mercury preparations	2-8			Aloes	8-12	Physostigmine	½-4
	Podophyllum	8-12			Senna A. B. and S. Pill (Laxative pill)	8-12 8-12	Saline Cathartics (when dilute) (when concentrated)	1-2 6-12
Drastic Cathartics			Jalap Elaterine Colocynth Gamboge Scammony Compound Cathartic Pill	2-4 ½-3 2-4 2-4 2-4 2-4			Croton Oil	½-2

Note: The cathartics that act slowly are best given at night.

SUMMARY OF PRINCIPAL CATHARTICS (Continued)

Time of Administration

Group	At Night	Before Breakfast	Between Meals	Special Methods of Administration
Laxatives	Cascara Sulphur Agar Agar		• Olive oil	Mineral oil (Liquid Petrolatum) 2 hrs. after meals
Purgatives	Podophyllum Phenolphthalein Compound Licorice Powder	Saline Purgatives	Calomel Mercury preparations Castor oil Rhubarb Aloes Senna A. B. and S. pill (Lapactic pill)	Physostigmine (hypodermically) Pituitrin
Drastic Cathartics			Croton oil Jalap Elaterine Colocynth Gamboge Scammony Compound Cathartic pill	Elaterine (hypodermically)

Types of Action

Pharmacological Action				Mechanical Action
<i>Salts, metals and other chemical substances</i>	<i>Oils</i>	<i>Anthracene substances (coal tar derivatives)</i>	<i>Resins</i>	
Calomel Mercury preparations Phenolphthalein Saline Cathartics (Salt action)	Olive oil Castor oil Croton oil	Cascara Frangula Rhubarb Aloes Senna	Podophyllin Jalap Elaterine Colocynth Gamboge Scammony	Liquid Petrolatum or mineral oil Agar Agar Psyllium Flaxseed

CHAPTER XIV

INTESTINAL ANTISEPTICS AND ANTHELMINTICS

INTESTINAL ANTISEPTICS

Intestinal antiseptics are drugs used to check the growth of bacteria in the gastro-intestinal tract. Most of the substances used for this purpose are made from coal tar. They are decomposed in the intestinal tract by the action of the pancreatic and intestinal juices into their constituent substances, which then check the growth of bacteria in the intestines. The most commonly used substance for this purpose is naphthol and its preparations.

Preparations

Naphthol	0.2-0.6 Gm.	grs. iii-x
Betanaphthol Benzoate (Betanaphtholi Benzoas)	0.2-0.5 Gm.	grs. iii-viii
This is used as an intestinal antiseptic in diarrhoea and typhoid fever. It is also used externally in 3-10% ointments.		
Betanaphthol Salicylate (Betanaphthol Salicylas)	0.3-0.5 Gm.	grs. v-viii
Bismuth Betanaphtholate (Bismuthi Betanaphtholas)	0.3-0.6 Gm.	grs. v-x

This is used to check diarrhoea and as an intestinal antiseptic.

Other Intestinal Antiseptics

Salicylic Acid	0.6 Gm.	grs. x
Resorcin	0.6 Gm.	grs. x
Sodium Sulphocarbolate	0.6 Gm.	grs. x
Bismuth Sulphocarbolate	0.6 Gm.	grs. x
Bismuth subsalicylate	1.0 Gm.	grs. xv
Acetylsalicylic Acid (Aspirin)	0.3 Gm.	grs. v
Salol	0.3 Gm.	grs. v
Creosote	0.3 c.c.	m. v
Thymol	0.3-0.6 Gm.	grs. v-x
Ichthyol	0.6-2.0 Gm.	grs. x-xxx
Calcium Ichthyol		
Ichthalbin		
Ichthoform		
Calomel		
Volatile Oils		

ANTHELMINTICS

Anthelmintics are drugs principally used to destroy or expel intestinal worms. The drugs which destroy these worms are often called **vermicides**, and those which expel them, **vermifuges**. This difference in their action really depends, however, upon the amount of drug given, and how soon after administration the bowels are moved. Thus, a large dose of one of the anthelmintics, if it remains in the intestine, will destroy, while a smaller dose will merely expel the worm.

With the exception of pelletierine, which has a specific action on tape worms, most of the anthelmintics do not affect the worms selectively.

All the anthelmintics are poisonous both to the worm and to the patient, but they are very slowly absorbed, so that their poisonous action is manifested mainly on the worm. Occasionally, if they are not followed by a cathartic, the drugs may be absorbed, and poisonous symptoms then result.

The anthelmintics are best classified according to the particular worm for which they are used.

The following are the most common worms which often occur in the intestines:

1. Tape Worms, or *Taeniae*.
2. Round Worms, or *Lumbrici*.
3. Thread Worms, Seat Worms or *Ascarides*.
4. Hook Worms, or *Uncinariae*.

The diagnosis of the form of worm is usually made by finding the characteristic eggs in the stools.

Administration

In giving any of the anthelmintics, it is important that the following routine measures be carefully carried out:

1. The patient should be given a very light diet, a day or two before the drug is administered, or better still, no food should be given for twenty-four hours before.

The bowels should be thoroughly moved with a light laxative, the day before administration.

3. The drug should best be given early in the morning on an empty stomach.

4. About four to eight hours after the administration, a brisk cathartic such as calomel or castor oil, should be given, to expel the worm. Occasionally a cathartic like calomel is given together with the drug.

No food should be given until the bowels have moved.

TAENICIDES

Taenicides are drugs which destroy or remove tape worms.

Tape worms are long flat worms which consist of many segments. They often inhabit the intestine as a result of eating beef or pork infected with their eggs. The substances used to destroy tape worms are the following:

Aspidium	Pepo
Cusso	Kamala
Granatum	Turpentine

MALE FERN (ASPIDIUM FILIX MAS)

Male fern or filix mas is obtained from the underground stems of the *Dryopteris filix mas* and of *Dryopteris marginalis*, European ferns.

The active principles of these plants are a number of neutral and acid substances such as *aspidin*.

Action: When taken internally, male fern has a very unpleasant, nauseating taste, and **destroys tape worms and hook worms.**

Poisonous Effects

In some individuals, if large doses of *aspidium* are given, it may be absorbed and cause the following symptoms:

1. Abdominal pain.
2. Nausea, vomiting and diarrhoea.
3. Frequent urination.
4. Muscular twitchings.
5. Collapse and coma.

Preparations

Oleoresin of <i>Aspidium</i> (<i>Oleoresina Aspidii</i>)	2.0-8.0 c.c.	$3\frac{1}{2}$ -ii
Filicic Acid Amorphous (<i>Acidum Filicicum Amorphum</i>)	0.5-1.0 Gm.	grs. viii-xv
Filmaron	10 c.c.	$3ii\frac{1}{2}$

This is a substance obtained from an ethereal extract of *aspidium*. It is said to be safer than *aspidium*.

Filmaron oil is a 10% solution of filmaron in castor oil.

CUSSO

Cusso, kousso or brayera, are the female flowers of *Hagenia abyssinica* or *Brayera anthelmintica*, an Abyssinian tree. The active principle is a neutral resin, *kosotoxin*, but it also contains tannic acid, a volatile oil and other substances.

Action: Cusso has a bitter taste and contracts mucous membranes. Its principal effect is to destroy tape worms.

Large doses occasionally cause nausea, vomiting, diarrhoea and rarely, collapse with an irregular pulse.

Cusso is usually given in doses of 15.0 Gms. ($3\frac{1}{2}$) of the powdered flowers in water as a suspension.

Fluidextract of Cusso (<i>Fluidextractum Cusso</i>)	4.0-16.0 c.c.	$3i$ -iv
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No cathartic is required after cusso, though the usual preparatory methods should be carried out.

GRANATUM (POMEGRANATE)

Granatum is the bark of the stem and root of *Punica granatum* or pomegranate. Its active principle is an alkaloid pelletierine or punicine.

Action: Granatum and its alkaloids have a specific destructive action on tape worms. It has a very unpleasant taste and is not a safe drug to use.

Overdoses of pelletierine or granatum produce the same symptoms of poisoning as aspidium.

Administration: Granatum is usually given as a decoction made from about 30.0–60.0 Gms. (℥i–ii) of fresh bark, in about 250.0 c.c. ($\frac{1}{2}$ pt.) of water. The drug is then given in two parts at intervals of an hour each, and the last dose should be followed in a half to two hours by a cathartic.

Preparations

Fluidextract of Pomegranate (Fluidextractum Granati)	2.0 c.c.	m. xxx
Pelletierine Tannate (Pelletierinae Tannas)	0.25 Gm.	grs. iv

This is a mixture of all the alkaloids of pomegranate bark.

PEPO (PUMPKIN SEED)

Pepo is the ripe seed of *Cucurbita pepo* or the ordinary pumpkin. Its active principle is a fixed oil and a resin.

Pumpkin seeds are used as a harmless remedy for tape worms.

Administration: The patient should fast the day before the drug is to be given, and the following morning, about two to four ounces of the seeds, beaten up in an emulsion of sugar and water, or honey, should be given. Occasionally, 15.0 c.c. ($\frac{3}{2}$) of the oil is given. It should always be followed by a cathartic several hours later.

Pepo or Pumpkin Seeds	30.0–120.0 Gms.	℥i–iv
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KAMALA

Kamala is a reddish brown powder consisting of the minute glands and hairs from the capsules of *Mallotus philippensis*, an East Indian shrub.

Kamala destroys the tape worms and causes profuse diarrhoea so that no cathartic is necessary after its use.

Preparations

About 4.0–8.0 Gms. (℥i–ii) of the powder is given in syrup, and repeated in two hours if the bowels do not move. A tincture of kamala is also occasionally used.

TURPENTINE

Turpentine destroys tape worms and round worms. It is given in doses of 30.0 c.c. (℥i) with twice its amount of castor oil. It is also given in very small doses, together with other anthelmintics. It is very apt to cause poisonous symptoms and is therefore not frequently used.

LUMBRICIDES

Lumbricides are drugs which destroy round worms. Round worms are small cylindrical worms which are often found in the small intestines of children. The substances used to destroy round worms are *santonin* and *spigelia*.

SANTONIN

Santonica or *levant worm seed* is the dry unopened flower heads of the *Artemisia pauciflora*, a plant growing in Asia Minor. *Santonin* is the active glucoside of *Santonica*.

Action

Santonin destroys round worms or *ascaris lumbricoides*, in the intestines. It has also been used to relieve the pains of locomotor ataxia and diabetes.

Action After Absorption

The absorption of some of the *santonin*, causes, in many cases, a very characteristic and peculiar disturbance of vision known as *xanthopsia*, or "yellow vision."

At first all objects seem to have a blue color, but this effect lasts for a very short time, and is soon followed by a condition where all objects seem to have a yellow tint.

Santonin is excreted by the urine, to which it gives a characteristic yellow or reddish color.

Poisonous Effects

Overdoses of *santonin* not infrequently cause poisonous symptoms, especially in children. Death has resulted from 0.3 Gm. (grs. v).

Symptoms

1. "Yellow vision."
2. Nausea and vomiting.
3. Twitchings of the muscles of the head.
4. Convulsions, delirium and temporary loss of speech or temporary blindness.
5. Collapse (slow, weak pulse, moist, cold skin, dilated pupils, etc.).

Treatment

The stomach should be washed out; emetics and cathartics are given. The convulsions are treated with chloroform or ether.

Preparations

Santonin, the active principle, is the drug which is principally used.

Santonin	0.03-0.2 Gm.	grs. $\frac{1}{2}$ -iii
(Santoninum)		

For a child 2 years old, 0.015 Gm. (gr. $\frac{1}{4}$) should be given.

Troches of Santonin
(Trochisci Santoninae)

Each troche contains 0.03 Gm. (gr. $\frac{1}{2}$) of *santonin*.

For a child, only 1 should be given.

SPIGELIA (PINK ROOT)

Spigelia or pink root is the root of the *Spigelia marilandica*, or *carolina pink*, a plant growing in the southern United States.

It is used to remove round worms. As it does not destroy the worm, it must be followed by a brisk cathartic.

Poisonous Effects

Overdoses of *spigelia* have occasionally produced muscular twitchings, stupor and collapse.

Fluidextract of <i>Spigelia</i>	4.0–8.0 c.c.	3i–ii
(Fluidextractum <i>Spigeliae</i>)		

For a child, 0.6 c.c. (m. x) is given on a piece of sugar, often together with *senna*.

CHENOPODIUM

Chenopodium or American worm seed, is the fruit of the *Chenopodium ambrosioides*, or Jerusalem oak, an American plant. Its active principle is a volatile oil, which has an extremely unpleasant odor. 1

It is used principally as a remedy for round worms. It is also used for the treatment of pin worms and tape worms. It is now being successfully used as a remedy for hookworm disease.

Administration

Chenopodium is very constipating. Consequently a dose of castor oil or a saline purgative should be given in the morning of the day before giving *chenopodium*. The patient should be kept on a liquid diet all that day. The following morning another dose of castor oil or a saline purgative is given. An hour later a capsule containing 0.3–0.6 c.c. (m. v–x) of an emulsion of *chenopodium* is given and the dose is repeated two and four hours later. Three hours after the last dose a dose of castor oil containing about 1.0 to 2.0 c.c. of chloroform water is given. No food is given for the rest of the day. The treatment is repeated every week until the patient is cured.

Poisonous Effects

Poisoning from *chenopodium* is not uncommon. The nurse should watch for persistent drowsiness which is usually the first symptom.

Symptoms

1. Drowsiness.
2. Nausea, vomiting and diarrhoea with stools containing blood and mucus.
3. Mental depression and great weakness.
4. Collapse, convulsions and paralyses.

Oil of <i>Chenopodium</i>	0.2–0.3 c.c.	m. iii–v
(Oleum <i>Chenopodii</i>)		

This is usually given on sugar or in an emulsion.

Senna and *Calomel* are also frequently used to remove round worms.

DRUGS WHICH DESTROY THREAD WORMS

Thread worms are small cylindrical worms which often inhabit the large intestine. They are easily removed since they do not cling to the intestinal wall. The patients suffering from these worms are usually treated by enemas of the following substances:

- | | |
|---|--------------------------------------|
| 1. Quassia | 5. Tannic Acid (1 to 2500 solutions) |
| 2. Alum (1 to 250 solutions) | 6. Calumba |
| 3. Sodium Chloride | 7. Lime Water |
| 4. Phenol ($\frac{1}{2}\%$ solution) | 8. Vinegar |
| 9. Quinine Bisulphate (1 to 2000 solutions) | |

DRUGS WHICH DESTROY HOOK WORMS

Hook worms, *uncinaria americana*, or *anchylostoma duodenale*, are small cylindrical worms which frequently inhabit the small intestine or duodenum.

Many people in the Southern United States, Switzerland and Egypt suffer from these worms, which cause a very severe form of anaemia.

The drug which is principally used to destroy hook worms is **thymol**.

THYMOL

Thymol is a stearoptene resembling carbolic acid chemically, which is obtained by evaporating the oil of thyme. This is a volatile oil obtained from *Thymus vulgaris* and other similar herbs which are found in most countries.

Action

Thymol produces the following effects:

1. It acts as an antiseptic on the skin and mucous membranes.
 2. It checks the growth of bacteria in the intestines; thereby lessening fermentation.
 3. It is said to lower temperature, and it produces perspiration.
- It is used frequently as an antiseptic gargle and mouth wash and as an intestinal antiseptic.

Thymol is used principally as a remedy for Hookworm disease for which it is almost a specific. Hookworm disease is a very prevalent disease in the South. It is due to the presence of hookworms in the intestinal tract. The disease is characterized by severe anaemia, laziness, mental dullness, retardation of growth and perverted appetites (loss of appetite, the eating of chalk, hair, or clay). The Chalk Eaters in the South suffer from Hookworm disease.

The parasite usually enters the body from the ground, through the skin between the toes or the soles of the feet. At the site of entry they form characteristic pustules, the so-called "ground-itch" pustules.

Thymol is also used as a remedy for Trichinosis, a disease produced by a parasite, the *Trichina Spiralis*, lodging in the muscles. The parasite

enters the body from the intestinal tract. In this disease it is given hypodermically in doses of 0.12–0.2 Gm. (grs. ii–iii) in olive oil every day.

Administration

The following method of giving thymol is the one adopted by the United States Public Health Service in its extensive campaign for the eradication of Hookworm Disease in the South.

1. Give a dose of magnesium sulphate the night before.
 2. At 6 A. M. the following morning give 1.0–2.0 Gms. (grs. xv–xxx) in 0.3 Gm. (grs. v) capsules mixed with milk sugar or sodium bicarbonate.
 3. At 10 A. M. another dose of magnesium sulphate should be given.
- The dose for children is half the adult dose, given in the same manner.

Poisonous Effects

Poisoning from thymol is not uncommon. The symptoms are principally ringing in the ear, nausea, vomiting, and collapse.

Calomel, Oil of Chenopodium, Naphthol and Magnesium sulphate are also frequently used to destroy hook worms.

Carbon Tetrachloride in doses of 2.0–3.0 c.c. is used as a remedy for hook worms and round worms.

PART IV—DRUGS USED PRINCIPALLY FOR THEIR EFFECTS UPON THE BLOOD AND CIRCULATION

CHAPTER XV

HAEMATINICS

BLOOD STIMULANTS OR TONICS

Tonics are drugs which strengthen the patient and improve the general health. They usually act by improving the character of the blood. The substances principally used as tonics are **iron** and **arsenic**. **Quinine** and **strychnine** also act as tonics by aiding the appetite because of their bitter taste.

Physiology of the Blood

The blood is a thick red fluid, which supplies all the tissues and organs of the body with nourishment and oxygen. It also takes away all the waste products, resulting from their various activities. These waste products are brought to the lungs, kidneys and intestines where they are excreted.

The blood consists of a straw colored fluid (plasma) in which float small round cells called corpuscles. The corpuscles are of two kinds: **red corpuscles** and **white corpuscles**, or **leucocytes**.

The red corpuscles contain a protein substance, haemoglobin, which contains iron and which imparts the red color to them.

The haemoglobin of the red corpuscles takes up oxygen from the air in the lungs; and brings it to all the organs of the body where it is used up by their various activities. The white corpuscles, together with the plasma, act as cleansers of the blood. They destroy bacteria in the blood and help to neutralize their poisons by the formation of antidotes. The white corpuscles then carry the dead bacteria to the kidneys, intestines and other organs for excretion.

Formation of Blood

The plasma is formed from the digested food, which passes through the lining membrane of the intestine into the blood vessels. Some of the fatty constituents of the plasma first enter the lymphatic vessels, from which they finally reach the blood stream.

The red and white corpuscles are formed in the bone marrow and spleen. The haemoglobin is formed in the liver and spleen.

Effects of Drugs on the Blood

Drugs affect the blood in two ways:

1. Stimulation of the blood may be said to occur :

a. When the quantity of plasma or the number of red or white corpuscles, or both, is increased.

b. When the *quality* of the corpuscles is improved, for example, by increasing the amount of haemoglobin.

2. Depression of the blood may be said to occur :

a. When the quantity of blood is lessened by withdrawing some of its fluids.

b. When the *number of corpuscles* is reduced.

c. When drugs *combine with the haemoglobin* so that it is unable to take up oxygen from the air in the lungs.

In this chapter we shall consider only those substances which improve the condition of the blood (blood stimulants).

TRANSFUSION

When a patient has lost a great deal of blood or when he is suffering from a severe anaemia, the ideal treatment is to replace the blood lost by blood obtained from another individual. This is called a transfusion. Since the blood of one individual, however, may destroy that of another, individuals can be divided into groups according to whether their bloods will mix without destroying each others corpuscles. It is therefore essential, before performing a transfusion, to determine the compatibility of the blood of the donor with that of the patient.

Formerly, a transfusion was done by suturing (sewing) the artery of the donor to the vein of the patient. By this method, however, it was impossible to measure the quantity of blood used. The two methods now in vogue are the **direct** and the **indirect** method. The **direct method** consists of obtaining blood from the donor in a specially constructed syringe and injecting it into the patient's vein so rapidly that it has no time to clot. The **indirect method** consists of obtaining blood from a donor into a receptacle and adding sodium citrate to it to prevent its clotting and then injecting this prepared blood into the vein of the patient.

SODIUM CITRATE

Sodium citrate is now extensively used in preparing blood for transfusion by the indirect method. It prevents the clotting of the blood by combining chemically with the calcium salts. About 10 c.c. of a 2% solution is added to every 100 c.c. of blood taken from the donor. It also comes in sterile glass ampoules each containing 10 c.c. of a 2% solution.

THE SALTS OF THE BLOOD

The blood contains various salts, principally sodium chloride and very small quantities of potassium chloride and calcium chloride. The total percentage of the salts in the blood is 0.9%. A solution which contains these

salts in the percentages in which they occur in the blood will best maintain the integrity of the corpuscles. Such a solution is called Ringer's Solution and is occasionally used in laboratories and in medicine. For practical purposes the integrity of the corpuscles will be maintained just as well by a solution containing 0.9% of sodium chloride as by Ringer's Solution.

NORMAL SALT SOLUTION

Normal salt solution or physiological salt solution is a 0.85% sodium chloride (salt) solution, or a solution containing $8\frac{1}{2}$ parts of salt to 1000 c.c. of water. A solution of this strength has the same salt content as the blood and does not destroy red blood corpuscles. It is called an **isotonic** solution. A solution of salt weaker than this strength is called a **hypotonic** or **anisotonic** solution. Such a solution swells and finally ruptures the red blood corpuscles. This property of a solution is called **hemolysis**. A solution which contains more than 0.85% salt is called a **hypertonic** solution and will make the corpuscles shrivel up or crenate. This property is called **plasmolysis**.

A solution of 0.6% sodium chloride (salt) is also frequently spoken of as a physiological salt solution. This is often used when other substances are to be added to the solution which might tend to change the isotonic power of the fluid (the power of maintaining the integrity of the corpuscles).

Action

When a patient has lost a large amount of blood the heart may stop beating because the quantity of blood in the blood vessels may be insufficient for the heart to pump. The heart beats then become very weak and feeble which may ultimately result in death. In such cases, normal salt solution is often injected into the veins, into the tissues under the skin, or into the muscles. This supplies fluid for the circulation so that the heart will continue to beat and maintain the circulation of blood until new blood can be formed to replace the quantity lost.

The effect of an intravenous injection of normal salt solution is immediate. The heart beats become vigorous, the pulse becomes stronger and more bounding, and the patient feels stronger. The blood pressure is raised and life processes are generally accelerated.

Uses

In addition to its principal use in shock, collapse and haemorrhage, normal salt solution or physiological salt solution is also used as a medium in which to dissolve medicinal substances that are to be given by direct injection into the veins. Such solutions do not affect the integrity of the corpuscles.

Methods of Administration

1. Intravenous Infusion: This is the quickest method for getting normal salt solution into the blood.

The solution is injected into the median basilic, or into the median cephalic vein of the forearm, by means of a special apparatus which is held about two feet above the patient. The salt solution is allowed to flow through a long rubber tube and cannula, the cannula being inserted into the vein in a direction toward the heart.

2. Hypodermoclysis: This is a slower method of getting normal salt solution into the blood.

The solution is allowed to flow underneath the breasts, or into the thighs, through a large needle which is inserted into these regions. The needle is attached to a rubber tube connected with a bottle which contains the salt solution. The fluid is absorbed into the blood from the tissues underneath the breasts, or from the thighs.

3. Rectoclysis, or Murphy Method: This method consists in allowing the solution to flow into the rectum, drop by drop, through a catheter. This is attached by a long rubber tube, to a receptacle containing salt solution, which is held a few feet above the level of the bed. When the solution enters the rectum it is absorbed into the blood through the rectal mucous membrane.

In preparing normal salt solutions, it is better to use ordinary table salt and plain undistilled sterile water. Both of the substances contain minute quantities of calcium, which tend to prevent the undesirable effects that occasionally occur from the sodium.

HYPERTONIC SALT SOLUTION

Hypertonic salt solutions are frequently given by mouth as cathartics to remove fluid from the tissues. They have also recently been given by direct injections into the veins to remove fluid from the body and to modify certain disease processes by removal of fluid from the cells of various organs, such as the brain, the kidneys, the joints, etc.

RINGER'S SOLUTION

Ringer's solution is a solution containing the exact salts and the same percentages as they occur in the blood. It is used for the same purposes as normal salt solution but it is preferable because it contains all the salts found in the blood, as follows:

Calcium chloride	0.02%
Potassium chloride	0.02%
Sodium chloride	0.9 %
Sodium bicarbonate	0.01%

Ringer's tablets are tablets containing the salts found in the blood which make a Ringer's solution when dissolved in a definite quantity of water. The following is the formula of the Ringer's tablet:

Calcium chloride	0.05 Gm.
Potassium chloride	0.05 Gm.
Sodium chloride	2.25 Gms.
Sodium bicarbonate	0.025 Gm.

Another tablet contains **Dextrose**, 0.25 Gm. in addition.

When one of these tablets is dissolved in 250 c.c. of water it forms a Ringer's solution.

SUBSTANCES USED TO INCREASE BLOOD CLOTTING

Physiology of Blood Clotting

The blood has the peculiar property of changing from a liquid to a gelatinous solid state when it is removed from the blood vessels. This property of clotting prevents a serious loss of blood from haemorrhage. The formation of a clot in the opening of the bleeding vessel acts as a plug to prevent further loss of blood. If blood is allowed to stand for a short time after it has clotted it separates into two parts: a clear straw colored liquid, at the bottom of which is the dark red gelatinous clot.

Microscopic examination of the solid part of the clot reveals that it consists of a mass of red and white blood cells held together by a network of fibrin.

Three factors are necessary to enable blood to clot: **calcium salts**, **fibrin ferment** and contact with any substance other than the walls of the blood vessels. The fibrin network exists in the blood dissolved in the serum. In this dissolved state it is called **fibrinogen**. This fibrinogen is changed to **fibrin** by the action of a ferment **thrombin**. This ferment exists in the blood in the form of prothrombin which is changed into thrombin by the action of calcium salts and a substance called **thrombokinase** or **thromboplastin**. Thromboplastin is only formed during bleeding from the injured tissue, from the blood cells and from the blood platelets.

FIBRIN FERMENTS AND THROMBOPLASTIC SUBSTANCES

The following group of substances are used to aid the clotting of blood. They all contain **thromboplastin**. All the tissues which form thromboplastin contain a fatty-like substance (lipoid) called **kephalin** which is found in brain tissue. Consequently, various preparations have been made from a number of tissues containing **kephalin** and therefore **thromboplastin**, which have the property of clotting blood.

Uses

Thromboplastin, or substances containing it, is applied locally on gauze sponges to bleeding points to check haemorrhage. It is also used hypodermically or intravenously in 0.1 to 0.2% solutions in normal salt solution to check internal haemorrhage.

Thromboplastin preparations should not be used in diseases where the coagulation of blood or the formation of clots is detrimental; as in heart disease, aneurysm, etc.

Preparations

The preparations are usually yellowish granular powders which dissolve readily in water. They come in tablets of 0.5 Gm. (grs. viii) with 0.46 Gm. sodium chloride. They also come in 1.5 c. c. ampoules each containing a 3% solution, for hypodermic use and in 20 c. c. solutions for local use.

The solutions must always be fresh. They are prepared by dissolving the powder in normal salt solution and boiling for three minutes.

Kephalin

This is a substance prepared from chopped-up ox brains which contains thromboplastic substances.

Solution of Brain Extract

This is an extract of cattle brains containing thromboplastic substances. It comes in ampoules each containing 25 c.c.

Thromboplastin substances

This is the same as solution of brain extract.

Coagulen (Ciba)

This is an extract prepared from blood platelets containing thromboplastic substances.

Calcium salts in large doses are usually given to aid the clotting of blood (see page 378).

Normal Horse Serum

This is ordinary serum obtained by coagulating horses' blood and removing the serum. It is injected intramuscularly to increase the clotting of blood.

IRON (FERRUM)

Iron is a heavy metal; some of its preparations are used as drugs. Many foods, such as meat, eggs and some vegetables, contain a great deal of iron. In the body, iron is found principally in the haemoglobin of the blood; about one part of iron to 230 parts of corpuscles.

Appearance of Patient

When iron is administered no appreciable effects can be noticed on the patient until it is given for some time. After continued administration, however, there is a gradual but noticeable improvement in the general condition of the patient. The percentage of haemoglobin and the number of red blood cells in the blood is gradually increased. The patient feels brighter, is more alert and energetic and he gradually becomes

more robust. He looks better, has a ruddier color, his appetite and digestion are improved.

Action

Local Action: On the skin, iron causes no effect, but if it is applied to a bleeding surface, it stops the bleeding, by precipitating (hardening) the albumins of the blood, which then close up the bleeding vessel. **Mucous membranes** are contracted by preparations of iron (astringent action).

In the mouth: Iron has a distinct metallic taste, and shrinks the lining membrane of the mouth, making it feel dry. It also discolors the teeth, if used continually.

In the stomach: It contracts the lining membrane and occasionally causes nausea.

In the intestine: It contracts the lining membrane, checking the secretions, thereby producing constipation.

Action after Absorption

Part of the iron taken in food or as a medicine is slowly absorbed from the duodenum, the first part of the small intestine. After absorption it acts principally on the blood. The iron is carried to the spleen, where it is stored up for future use; and to the liver and bone marrow, where it helps to form haemoglobin for the red blood corpuscles. If iron is taken for any length of time, **the percentage of haemoglobin and the number of red blood corpuscles are increased.** The corpuscles contain more haemoglobin, which takes up more oxygen from the air in the lungs. All the organs and tissues of the body are then supplied with more oxygen, which enables them to perform their work better.

As a result of these effects, there is a mild general improvement in the patient's condition. The heart action is better, the digestion and breathing are improved, simply as the result of the improved quality of the blood. The patient feels stronger, is more energetic and active. (A drug which improves the general condition of the patient in this way is called a tonic.) The effect occurs slowly and insidiously, although at times, because the specific cause for the anaemia is not relieved, no appreciable effects are obtained.

Excretion

Only part of the iron taken as a medicine, or in the food, is absorbed. The rest is excreted by the intestines, in the stools.

On account of the large amount of iron present in the stools, the lining membrane of the intestines is contracted, and constipation results.

Uses

Iron is used principally in cases of **anaemia**, a condition in which the number of red blood corpuscles and the percentage of haemoglobin in the blood, is reduced. This occurs after a haemorrhage when the patient has lost a great deal of blood, or when he is suffering from some chronic disease, such as tuberculosis or cancer. It is used with best results in a peculiar kind of anaemia, occurring in young girls, called **chlorosis**.

Poisonous Effects

In some cases, after continued use of iron for any length of time, it produces the following symptoms: frontal headache, loss of appetite, pain in the pit of the stomach, occasionally nausea and vomiting, colic and invariably constipation. Sometimes the skin becomes covered with very small pustules (acne).

The condition is relieved by stopping the iron, and giving cathartics.

Administration

In giving iron, the nurse should remember the following rules:

1. Iron should always be given after meals, well diluted, in an albuminous fluid such as milk.
2. To avoid discoloring the teeth, iron should always be given through a glass tube or a straw, so that the drug does not touch the teeth.
3. To avoid constipation, the bowels should be moved regularly with some cathartic, or a preparation of iron should be given which contains a cathartic.
4. If a gargle containing iron is given, the teeth should be brushed and the mouth then rinsed with salt water after each administration.
5. Silver spoons are stained by iron; they should never be used in giving any of the preparations. Strong ammonia water removes these stains.
6. Iron stains clothing, sheets, carpets, etc. Oxalic acid removes these stains.

Incompatibilities of Iron

The following drugs cannot be given together with iron because they form chemical compounds with it:

Preparations of iron should never be given with tea, or with vegetable drugs containing tannin or tannic acid, as iron combines with these drugs and forms ink.

The alkaline preparations of iron should not be given with acids. For example, do not give Basham's mixture together with dilute acids, as they combine and form a sediment.

The iron salts of the mineral acids should not be given with alkalies. For example, do not give tincture of iron chloride with sodium bicarbonate, as they will combine and form a sediment.

Preparations

The following are the most efficient and most frequently used preparations of iron:

Blaud's Pills,
Tincture of Iron Chloride,
Syrup of Iodide of Iron,
Basham's Mixture,
Elixir of Iron, Quinine and Strychnine
and a number of the organic preparations.

There are a great many preparations of iron, but only the most important ones are included.

There are several preparations of iron which are only used for their local effects or to check bleeding.

For internal use there are two kinds of preparations: inorganic and organic.

The **inorganic** preparations are metallic salts of iron.

The **organic** preparations are preparations of iron combined with various proteins, such as egg albumin, etc.

The organic preparations do not contract mucous membranes as much as the inorganic ones; and are, therefore, not so apt to cause unpleasant symptoms after continued use.

Preparations for Local Use

Solution of Iron Subsulphate (Monsell's solution)
(*Liquor Ferri Subsulphatis*)

This preparation contains about 13% of iron.

Iron Chloride
(*Ferri Chloridum*)

This preparation is used in a 20% solution, or the pure crystals are allowed to take up moisture from the air by being exposed (deliquescent action), and are then used.

These two preparations are principally used to stop bleeding or to contract mucous membranes, either by local application, or in the mouth as a gargle.

Preparations for Internal Use

Inorganic Preparations

Solids

Pills of Iron Carbonate 1-5 pills
(Pilulae Ferri Carbonatis)
 (Blaud's pills)

These pills consist of iron sulphate, the carbonate of sodium or potassium, tragacanth, sugar and glycerin.

Each pill contains about 0.06 Gm. (gr. i) of iron. They should always be fresh. Old pills may pass through the intestines without causing any effects, or without being changed in any way.

Reduced Iron 0.06-0.12 Gm. grs. i-ii
(Ferri Reductum)
 (Quevenne's Iron)

This is a brown powder which is tasteless and does not contract mucous membranes. It is often given to children in candy.

Soluble Iron Phosphate 0.06-0.3 Gm. grs. i-v
(Ferri Phosphas Solubilis)

Iron Citrate 0.06-0.3 Gm. grs. i-v
(Ferri Citras)

Pills of Iron Iodide 1-3 pills
(Pilulae Ferri Iodidi)

Each pill contains 0.03 Gm. (gr. $\frac{1}{2}$) of reduced iron, also iodine, acacia, licorice and balsam of tolu.

Iron and Strychnine Citrate 0.12-0.3 Gm. grs. ii-v
(Ferri et Strychninae Citras)

This contains 1% of strychnine and 16% of iron.

Iron and Quinine Citrate 0.3-0.6 Gm. grs. v-x
(Ferri et Quininae Citras)

This contains 12% of quinine and 15% of iron.

Solid Preparations Combined with Cathartics

Iron and Potassium Tartarate 0.3-0.6 Gm. grs. v-x
(Ferri et Potassii Tartaras)

This contains 15% of iron.

Pill of Aloe and Iron 0.2-0.5 Gm. grs. iii-viii
(Pilulae Aloe et Ferri)

This contains dried iron sulphate and aloes. The aloes overcomes the constipating effect. It is often used in cases of scanty menstruation or absence of menstruation (amenorrhoea), in chlorosis.

Fluid Preparations

Tincture of Iron Chloride 0.3-2.0 c.c. m. v-xxx
(Tinctura Ferri Chloridi)
 (Muriated tincture of iron)

This is one of the best preparations of iron, and is very frequently used. It contains about 4% of iron in alcohol.

It is best given in milk or in glycerin, (3 parts of the preparation to one of glycerin) to prevent constipation, or in egg albumin, to prevent discoloration of the teeth.

Solution of Iron and Ammonium	15.0-30.0 c.c.	5 $\frac{1}{2}$ -i
Acetate		
(Liquor Ferri et Ammonii Acetatis)		
(Basham's mixture)		

This preparation contains very little iron and must be freshly made. It consists of the tincture of iron chloride, dilute acetic acid, solution of ammonium acetate, elixir of orange, glycerin and water.

Syrup of Iodide of Iron	0.3-2.0 c.c.	m. v-xxx
(Syrupus Ferri Iodidi)	well diluted	

This is an excellent preparation, especially for children. It contains about 2% of iron.

Elixir of Iron, Quinine and Strychnine Phosphate	4.0-8.0 c.c.	5i-ii
(Elixir Ferri, Quininae, et Strychninae Phosphatum)		

This preparation is very frequently used as a tonic. It contains about 2% of iron phosphate.

Each teaspoonful dose contains $\frac{1}{2}$ grain of iron phosphate and quinine and $\frac{1}{84}$ grain of strychnine.

Syrup of Iron, Quinine and Strychnine Phosphate	4.0-8.0 c.c.	5i-ii
(Syrupus Ferri Quininae et Strychninae Phosphatum)		

This preparation contains 9% of iron phosphate. Each teaspoonful dose contains grs. v of iron phosphate, $\frac{1}{80}$ grain strychnine and $1\frac{1}{2}$ grains of quinine.

Antidotes for Arsenic

Iron Hydroxide (Ferri Hydroxidum)

This preparation is used principally as an antidote for arsenic poisoning. About 8 grains of it will neutralize 1 grain of arsenic. It must always be fresh.

If iron hydroxide is not on hand, it can be made from the tincture of iron chloride, by adding ammonia water or sodium carbonate to it. A precipitate (sediment) will then form. Enough ammonia or sodium carbonate must be added until no more sediment forms. This sediment is then washed and strained, and given in milk; as often as is necessary to neutralize the arsenic.

Iron Hydroxide with Magnesia Oxide	15.0-30.0 Gms.	5 $\frac{1}{2}$ -i
(Ferri Hydroxidum cum Magnesii Oxido)		

This is made from iron sulphate, to which magnesia is added. It is the best antidote for arsenic poisoning.

Organic Iron Preparations

The following preparations of iron are made with organic substances such as proteins (albumins, peptones, etc.). They have no advantage over the other preparations of iron, except that they are more readily absorbed, and do not contract mucous membranes as much as the inorganic preparations.

Solid Preparations

Ferratin 0.5 Gm. grs. viii

This substance is made from egg albumin and iron.

Ferrous Lactate 0.06–1.3 Gm. grs. i–xx

This is a mild preparation of iron which is best given in syrup.

Fluid Preparations

Ferro Mangan 4.0–16.0 c.c. $\mathfrak{z}\text{i}-\mathfrak{z}\frac{1}{2}$

This is a solution of iron, manganese and peptones. There are several other similar preparations under various names, such as peptomanganate of iron, etc.

Ovoferri 8.0–16.0 c.c. $\mathfrak{z}\text{ii}-\text{iv}$

This is a preparation made from serum albumin and iron by an electrical process.

MANGANESE (MANGANUM)

Manganese is a metal. Many of its preparations are occasionally used in medicine. It is found in the body in the red blood corpuscles, the hair and bile, usually together with iron. Some of its preparations, especially potassium permanganate, are used as an antiseptic.

It is said to increase nutrition and the menstrual flow and is frequently given together with iron. It cannot replace iron, however, as it does not help to form haemoglobin.

Manganese Dioxide 0.12 Gm. grs. ii
(*Mangani Dioxidum*)

Potassium Permanganate 0.03–0.2 Gm. gr. $\frac{1}{2}$ –iii
(*Potassii Permanganas*)

This preparation gives off oxygen. It is often given in cases of poisoning from various drugs. For example, in morphine poisoning it is given to neutralize the morphine by the oxygen which it liberates, which then combines with the drug and makes it inactive.

It is also used as an antiseptic, acting in a similar manner, the oxygen destroying the bacteria.

ARSENIC

Arsenic is a metal which is commonly used in the manufacture of dyes and other commercial products.

It is one of the oldest drugs in medicine, and was very frequently used for criminal poisoning during mediaeval times. There are a number of compounds of arsenic, but only one group

of them is used in medicine. These are the compounds of arsenic trioxide, white arsenic or arsenious acid.

Appearance of the Patient

When small doses of arsenic are given for some time the number of red blood corpuscles are increased, the patient feels better, stronger and is more active. He looks more robust, he becomes stouter and has a ruddier color. The appetite is better and the bowels move more often.

Action

Local Action : Applied to the skin, arsenic causes inflammation and pain. If it is allowed to remain on the skin for a longer time, the skin is destroyed and an ulcer remains (escharotic or caustic action). Arsenic is slightly antiseptic. It is easily absorbed from the injured skin. **On mucous membranes,** when applied locally, it also causes redness and pain, with subsequent inflammation and destruction of the tissues.

In the stomach it causes a sense of heat, it increases the appetite and the secretion of gastric juice.

In the intestines, it increases the secretion of the mucous membrane, and the peristalsis, thus causing movements of the bowels.

Action after Absorption

Arsenic is rapidly absorbed from the stomach and intestines, as well as from all the mucous membranes. After absorption, it affects principally the blood and the tissues.

Action on the Blood : Arsenic increases the number of red blood corpuscles by increasing their formation in the bone marrow and destroys parasites in the blood such as the spirochaete of syphilis. Since the red blood corpuscles in the blood are increased, they are able to carry more nourishment and more oxygen to the organs and tissues of the body, and to remove more waste products. Thus it increases the activity of all the organs of the body in a manner similar to iron.

The patient is then healthier, more robust, has a better appetite and feels better. This is called a tonic effect.

Action on the Tissues : Arsenic prevents the tissues from being used up, by lessening their combination with oxygen. It therefore increases the growth and nutrition of the tissues and organs of the body. As a result of this action, if arsenic is taken for some time, the patient usually becomes somewhat stouter. The nutrition of the skin, hair, and nails is said to be especially improved.

Action on the circulation, respiration and nervous system:

As a result of the improvement in the general tone of the body, the circulation, the respiration and the function of the nervous system may be improved. The improvement in the nutrition of the nervous system produces a sedative effect and lessens muscular twitchings and nervous excitability.

Excretion

Arsenic is excreted mainly by the urine, also by the lining membrane of the stomach, intestines and bronchi. It is excreted very slowly and may therefore cause cumulative symptoms.

Tolerance

When arsenic is taken regularly in small doses, the patients are able to take comparatively large quantities of the drug without getting poisonous effects. A patient is then said to have a **tolerance** for arsenic. This is due to lessened absorption, which occurs from continued use.

In some countries, for example in the Tyrol, the peasants eat large quantities of arsenic, because it enables them to do their work better, and to climb the mountains with less effort. It is said to improve their complexion. These peasants often live to a very old age.

Women very often take arsenic for weeks or months at a time to improve their complexion and figure. Poisonous symptoms often occur as a result of such use.

Uses

Arsenic is used principally in **anaemia**, to improve the condition of the blood. It is used especially in those forms of anaemia in which the number of red corpuscles are diminished and in pernicious anaemia. It is often given together with iron.

Arsenic is also given for chorea (St. Vitus' dance), and as a tonic, to improve the general condition of the patient. Some of the newer preparations of arsenic are given as specifics for syphilis. It is occasionally used in Leukaemia, a disease in which the white blood corpuscles are increased, and in chronic malaria.

Poisonous Effects

There are two forms of arsenic poisoning:

1. Acute arsenic poisoning.
2. Cumulative arsenic poisoning.

Acute Arsenic Poisoning

This follows a single large dose of arsenic taken with suicidal intent or by mistake. Many rat and insect poisons contain large quantities of arsenic.

Symptoms

The following are the symptoms which occur in about fifteen minutes to an hour:

1. Burning pain in the oesophagus and stomach.
2. Profuse nausea and vomiting of bile stained serum containing small flakes of mucous membrane.
3. Severe abdominal cramps.
4. Profuse diarrhoea, with watery, bloody stools containing small flakes of mucous membrane (rice water stools).
5. Excessive thirst (due to loss of fluid).
6. Scanty, bloody urine.
7. Collapse: cold, moist skin, slow and shallow breathing, rapid, thready pulse, etc.
8. Coma and convulsions may occur before death, which results in from six hours to two days.

In some cases there may not be much nausea, vomiting or diarrhoea. The patient suddenly goes into collapse, has a few convulsions and dies.

If the patient recovers from the acute symptoms, paralysis of the muscles of the extremities may result, causing "drop feet" or "drop hands," from which he usually recovers, however.

Treatment

1. Iron hydroxide or iron hydroxide with magnesia is usually given until recovery.
2. Wash out the stomach, thereby removing the compound of iron and arsenic. Induce vomiting if a stomach tube is not at hand.
3. Protect the mucous membrane of the stomach and the intestines by giving mucilaginous drinks such as milk, olive oil, etc.
4. Give plenty of water.
5. Later, bismuth, chalk or opium may be given for the diarrhoea.
6. Abdominal cramps are usually relieved by a hot water bag and by atropine.
7. The collapse is usually treated with caffeine, atropine, strychnine, warm applications, etc.

Cumulative Arsenic Poisoning

Since arsenic is excreted more slowly than it is absorbed, cumulative symptoms, or chronic arsenic poisoning is very common. It usually occurs from the continued medicinal use of arsenic preparations. It may also result from inhaling fumes of arsenic, in rooms papered with wall paper containing arsenic dyes, from wearing clothing dyed with arsenic, or by eating food colored with arsenic dyes. The following symptoms, in the order of their onset, are noticed after prolonged administration. Often the later symptoms appear before the earlier ones.

Symptoms

1. Itching of the eyelids.
2. Redness of the conjunctiva of the eye.
3. Puffiness about the eyes, especially in the morning.
4. Sneezing or "running nose" (coryza).
5. Loss of appetite, heaviness in the stomach, nausea and vomiting.
6. Skin eruptions; red spots, areas of brownish discoloration (very often they look like freckles) on the face or the abdomen. Dark discolorations on the skin of the abdomen, which look like pencil marks.

In severe cases, the hair and nails may fall off.

7. Cramp-like abdominal pains.

8. Diarrhoea, with "rice water" stools; the rice water appearance of the stools is due to small flakes of the lining membrane of the intestine which they contain.

The following symptoms appear later and only in severe cases:

9. Persistent headache.
10. Pains around the knee, ankle, foot and hands.
11. Redness and swelling of the hands and feet.
12. Areas of skin which are very sensitive to touch, to pain, to heat and cold. This occurs especially on the extremities.
13. In severe cases there are paralyses of the extensor muscles of the hands and feet, resulting in "drop feet" and "drop hands."

Treatment of Chronic Arsenic Poisoning

If the arsenic is stopped and cathartics given, the symptoms usually gradually disappear. The paralyses must be treated by massage and electricity, until the muscles recover, which they usually do.

Administration

Arsenic preparations should be given well diluted in a large glass of milk after meals. Some preparations are given hypodermically.

Preparations

Fluid Preparations

Solution of Potassium Arsenite (Liquor Potassii Arsenitis) (Fowler's solution)	0.06-0.5 c.c.	m. i-viii
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This contains 1% of arsenic trioxide, potassium bicarbonate and tincture of lavender.

Every m.v of Fowler's solution contain gr. $\frac{1}{20}$ of arsenic trioxide.

Solution of Sodium Arsenite (Liquor Sodii Arsenitis) (Pearson's solution)	0.06-0.5 c.c.	m. i-viii
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Solution of Arsenious Acid (Liquor Acidii Arsenosi)	0.06-0.5 c.c.	m. i-viii
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This contains 1% of arsenic trioxide and dilute hydrochloric acid.

Solution of Arsenious and Mercuric Iodides (Liquor Arseni et Hydrargyri Iodidi) (Donovan's solution)	0.1-0.3 c.c.	m. i $\frac{1}{2}$ -v
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This is the strongest arsenic preparation. It contains 1% each of arsenic iodide, and of red mercuric iodide. It may cause symptoms of mercury poisoning.

Solid Preparations:

Arsenic Trioxide (Arsenii Trioxidum)	0.001-0.005 Gm.	gr. $\frac{1}{60}$ - $\frac{1}{12}$
Sodium Arsenate (Sodii Arsenas)	0.001-0.005 Gm.	gr. $\frac{1}{60}$ - $\frac{1}{12}$
Arsenic Iodide (Arsenii Iodidum)	0.003-0.01 Gm.	gr. $\frac{1}{20}$ - $\frac{1}{8}$
Arsen Triferrin	0.3 Gm.	grs. v.

This is a compound of iron, arsenic, phosphorus and albumin.

Soamin

This is sodium arsanilate, and contains 22% of arsenic. It usually comes in tablets each containing 0.06-0.3 Gm. (grs. i-v) of soamin.

Arsphenamine (Salvarsan)	0.3-0.6 Gm.	grs. v-x
Neoarsphenamine (Neosalvarsan)	0.3-0.6 Gm.	grs. v-x

These are arsenic preparations given intravenously as specifics for syphilis (see page 423).

Preparations for Hypodermic Use

Sodium Cacodylate (Sodii Cacodylas)	0.015-0.06 Gm.	gr. $\frac{1}{4}$ - i
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This is a compound of cacodylic acid, which is a compound of arsenic. It is given hypodermically and is said to cause no unpleasant symptoms.

Calcium Cacodylate (Calcii Cacodylas)	0.03-0.3 Gm.	grs. $\frac{1}{2}$ - v.
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This is a calcium salt of cacodylic acid which comes in ampoules for intramuscular and intravenous injections.

Iron Cacodylate
(Ferri Cacodylas)

0.03-0.06 Gm.

gr. $\frac{1}{2}$ -i

This is a compound of iron and arsenic which comes in 1.0 c.c. ampoules for intramuscular injections.

Atoxyl

This is sodium arsanilate, and comes in tablets of 0.02 Gm. (gr. $\frac{1}{3}$) for hypodermic use.

BENZOL

Benzol is an oily, colorless, inflammable liquid made from coal tar. It is used as a solvent in metal manufacturing. The fact that very severe anaemias occur among such metal workers is responsible for its use in medicine for conditions where there is an increase in the number of blood cells.

It is, therefore, used in the treatment of Leukaemia, a progressive and fatal disease characterized by a marked increase in the number of leucocytes in the blood and a change in their character. Benzol causes destructive changes in the bone marrow where the blood cells are formed as a result of which the number of leucocytes diminish and the patients improve, but the improvement is not permanent, however. It is given in doses of 0.5 to 1.0 c.c. in milk or olive oil.

Benzol must not be confounded with benzine, an entirely different substance made from petroleum.

CHAPTER XVI

CIRCULATORY STIMULANTS

Physiology of the Circulation of the Blood

The blood supplies all the organs and tissues of the body with nourishment and takes away their waste products. It reaches these organs and tissues, through numerous small elastic tubes, the arteries. These gradually divide into smaller and smaller branches the narrowest of which are called capillaries. The blood is kept constantly flowing through these vessels by the rhythmic action of a complicated pump, the heart.

The impure blood resulting from the action of the tissues and organs is being constantly brought back to the heart by means of a system of tubing called the veins.

Physiology of the Heart

The heart is a pear-shaped organ, about the size of one's fist, situated in the left side of the chest. It consists of four chambers. Two of these chambers receive blood into the heart from the veins, and are called **auricles**, while the other two send blood out to the organs and tissues of the body and are called **ventricles**.

The **right auricle** receives impure blood (blood containing waste products) from the various organs and tissues of the body through the veins, which enter the heart by two main vessels: the superior and inferior vena cava. The impure blood is then pumped into the next chamber, which is the **right ventricle**. From the **right ventricle** it is pumped into a large artery, the **pulmonary artery**, through which it reaches the lungs. Here carbon dioxide gas, a waste product, is excreted by the corpuscles. In return, the red corpuscles **take up oxygen** from the air in the lungs.

This **purified blood** is now carried back along the **pulmonary veins**, to the **left auricle**, and from there it is pumped into the **left ventricle**. The **left ventricle** pumps the blood into the large arteries: the **aorta** and **its branches**. The blood then passes through these arteries and their branches, to the various organs and tissues of the body, supplying them with oxygen and nourishment. In return it takes away the waste products from these tissues and organs which it brings back to the heart and thence to the lungs, where they are excreted, and new oxygen obtained instead.

The passage of the blood, to the various parts of the body from the heart along the arteries, and then back again to the heart along the veins, is called the **circulation of the blood**.

The blood is kept circulating by the regular rhythmic contractions of the heart, which in normal healthy individuals, occur about 72 times a minute.

Each contraction consists of two parts or phases:

1. The period of contraction, which is the time when the heart becomes

smaller and expels its contents, the blood. This is called the **systole of the heart**.

2. The period of relaxation, or period of rest, which is the time when the heart becomes larger, and contains a greater amount of blood. This is called the **diastole of the heart**.

Physiology of the Heart Muscle

It is now generally believed that the heart contracts because of characteristic intrinsic properties of the heart muscle. These properties are independent of the impulses which reach the heart through its nerves. This may be proved by a number of facts; for example, that the hearts of some animals will contract for a short time when the nerves are severed from the heart; in fact even when the heart is removed from the body. Physiologists have therefore studied the nature of the contractions of the heart and have brought to light the following facts:

(1) The heart muscle, like other muscles, has the following properties: **irritability, tone and contractility**.

Irritability is the property whereby muscles are constantly ready to respond to a stimulus.

Tone is the property whereby muscles maintain a state of constant mild contraction.

Contractility is the property whereby muscles are able to contract, that is, to become shorter and thicker. The heart muscle differs from other muscles, however, in its contractility. Whenever it contracts at all, it always contracts to the greatest degree.

(2) Living normal heart muscle always contracts rhythmically.

(3) The auricles and ventricles of the heart are both capable of contracting independently of one another. When they do so, the auricles and ventricles beat at different rates. The auricles then beat about three times as fast as the ventricles, whose intrinsic rate is about forty to the minute.

(4) Contractions of the auricles are transmitted to the ventricles along a bundle of muscle fibers, which runs in the septum of the heart, from the auricles to the ventricles and is called the **auriculo-ventricular bundle**, or **bundle of His**.

(5) The wave of contraction of the heart begins at a point in the right auricle where it is joined by the great veins (Superior and Inferior Vena Cava). This spot is called the **sinus node**. It is the most irritable part of the heart and is frequently called the **pace maker** of the heart because it starts the contraction.

Method of Contraction

(1) The stimulus at the sinus node starts the contraction of the auricles. This contraction wave is transmitted to the ventricles by the auriculo-ventricular bundle. Ventricular contractions then follow about a fifth of a second later. These ventricular contractions pump blood into the arteries and give the pulse its rate.

These rhythmic contractions occur about 72 times to the minute in the following order:

- Contraction of the Sinus Node
- Contraction of Auricle
- Contraction of Ventricle

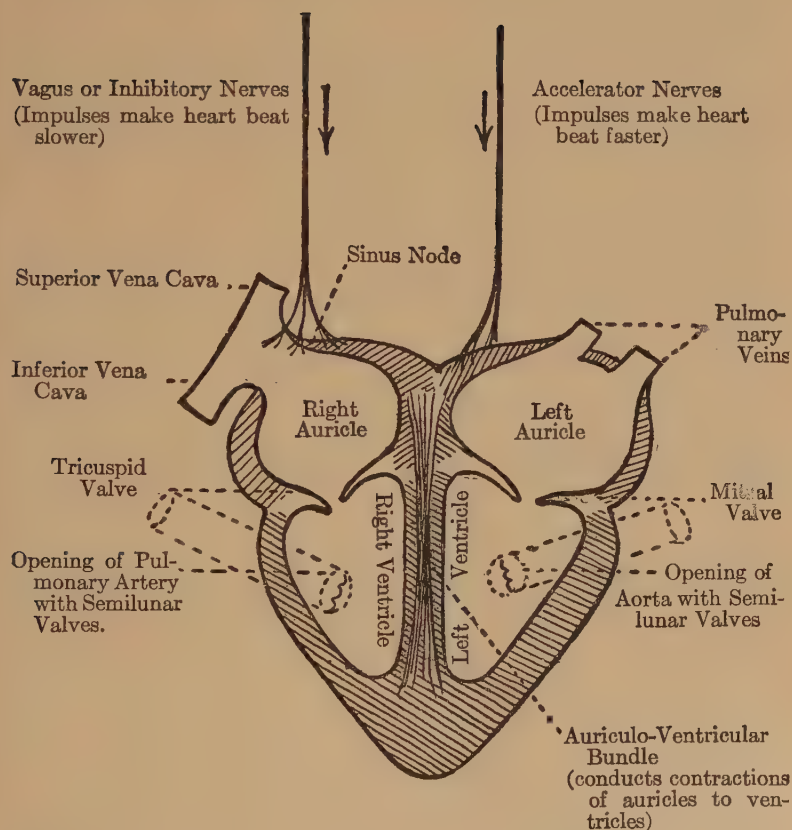


Diagram of the heart showing the position of the auriculo-ventricular bundle, and the nerves.

Each contraction is followed immediately by its period of relaxation or diastole.

Factors which Modify the Contractions of the Heart

The contractions of the heart can be affected by the following influences:

1. By **impulses** coming from the medulla of the brain, along special branches of the sympathetic nervous system going to the heart called the **accelerator nerves**. The impulses transmitted by these nerves, make the heart beat **stronger and faster**. As a result, the contractions or **systoles are stronger**, and **more frequent**; while the periods of relaxation or diastoles of the heart are diminished.

2. By **impulses** coming from the medulla of the brain along special nerves going to the heart called the **Vagus, Pneumogastric or inhibitory nerves**. These impulses make the heart beat **slower and weaker**. As a result, the relaxation periods, or **diastoles**, are **greater and more prolonged**. The contractions or systoles, therefore, occur less frequently because the periods of relaxation of the heart, or diastoles, take up so much time.

3. **The width of the blood vessels**, especially of the very small arteries, also influences the contractions of the heart.

When the **blood vessels are contracted**, the heart must beat **stronger**; because the narrow blood vessels offer a greater resistance to the contractions of the heart.

When the **blood vessels are dilated**, the heart does not have to contract so forcibly to propel the blood through the widened blood vessels, because they offer little resistance to the flow of blood.

The width of the blood vessels is regulated by small muscle fibers in their walls. The contractions of these muscle fibers make the blood vessels narrower. By the relaxation of these muscles, the blood vessels become wider.

Impulses are constantly being sent from a spot of gray matter in the medulla of the brain (the vaso motor center), which cause these muscle fibers to either contract or relax, and thereby regulate the size of the blood vessels.

Effects of Drugs on the Heart

Drugs affect the heart in two ways:

1. They **increase** its activity (stimulation).
2. They **diminish** its activity (depression).

Stimulation of the Heart

When drugs increase the activity, or stimulate the heart, they make it beat **stronger and faster**. The contractions or systoles of the heart are stronger, while the periods of relaxation or diastoles are lessened. The pulse is therefore usually stronger and more rapid, because the character of the pulse depends largely on the contractions of the heart. Practically, however, most heart stimulants also act upon the heart to make it beat slower. This is a beneficial effect, as it prevents the heart from becoming exhausted.

Depression of the Heart

When drugs lessen the activity of the heart (or depress it), the heart beats **slower and weaker**. The contractions or systoles are lessened, while the periods of relaxation or diastoles, are increased. The heart therefore beats slower and weaker producing a slow and weak pulse.

Effects of Overdoses

In overdoses, the effects of a heart stimulant or of a heart depressant may be the same. For example, when the heart action is increased, the heart beats strong and fast, but when it is overacting and is exhausted, the beats become slow and weak. In poisonous doses, then, a heart stimulant may cause symptoms of depression.

A drug which lessens heart action, however, or a heart depressant, always makes the heart beat slow and weak. In overdoses, such a substance makes the heart beat even slower and still weaker.

COMMON DISEASES OF THE HEART

The following are the more common diseases of the heart which the nurse has an opportunity to observe:

Myocardial Insufficiency

(Failing Compensation or Weakened Heart Action)

The contractions of the heart keep the blood circulating through the blood vessels, so that the tissues and organs of the body may be supplied with nourishment and oxygen, and their waste products removed.

When disease affects the valves of the heart, the valve openings become narrower (stenosis), or the valves do not close completely and leak (regurgitation). The heart overcomes the resulting disturbed flow of blood in its cavities, by thickening its wall. The heart is then able to contract with greater force so as to overcome the leaking or narrow valves, and it is then said to be compensated.

When, however, the heart muscle is weak, or when there is auricular fibrillation so that the rhythm is disturbed, the blood cannot be moved along the blood vessels fast enough. Some of the blood then accumulates in the veins; of the lungs, of the extremities, and of the abdomen.

When the blood accumulates in the blood vessels of the lungs, the air sacs become narrower. To obtain the necessary amount of air the patient has to breathe faster and deeper. The blood corpuscles cannot take up enough oxygen, and the blood becomes darker in color, which causes the skin of the face and hands to become blue.

Some of the blood also accumulates in the veins and capillaries of the extremities. Part of the serum of this accumulated blood oozes through the walls of the vessels into the surrounding tissues, which become full of fluid. This is called oedema. It occurs especially in the lower extremities which become swollen.

In the abdomen, too, the accumulation of the blood, in the blood vessels of the stomach and intestines, results in congestion and oedema of the stomach and intestines. This causes nausea, vomiting and diarrhoea.

The accumulation of the blood in the kidneys, results in lessened secretion of urine, because the kidneys are not supplied with sufficient fresh blood from which to excrete urine.

The serum of the blood sometimes oozes through the walls of the blood vessels into the abdomen, filling it up with fluid. This is called ascites.

As a result of weakened heart action or fibrillation of the auricles, the patient presents the following picture:

At first he is **very short of breath and the face is blue** (cyanosed). Later **the extremities are swollen** (oedema), and in some cases the patients have nausea, vomiting and diarrhoea. The pulse is rapid, irregular and weak, and the daily quantity of urine is diminished.

Acute Myocardial Insufficiency

(Sudden Weakened Heart Action)

This condition frequently results from shock, following operations or from collapse from any cause. As a result the tone and contractile power of the heart muscle is lessened. The condition is characterized by a weak, regular, either rapid or slow pulse.

Fibrillation

When the heart muscle becomes excessively irritable, all its bundles of fibers do not beat in harmony and its rhythm is therefore disturbed. This condition is known as **fibrillation**. It is usually due to increased irritability of the heart as a result of disease or other conditions. **Auricular fibrillation** is a condition in which groups of muscle fibers in the auricles beat by themselves and thus disturb the rhythm of the heart. The condition is recognized when the heart beats are more rapid than the pulse, some of the beats being so weak that they are not transmitted. **Ventricular fibrillation** is a condition in which bundles of muscle fibers of the ventricles beat independently, thus disturbing the rhythm of the ventricles. This condition is usually fatal.

Heart Block

When the auricular contractions fail to reach the ventricles, because the passage of contraction waves along the auriculo-ventricular bundle is interfered with, the condition is called **heart block**. The auricles and ventricles then beat independently of one another but each at its own intrinsic rate; the ventricles beating much slower than the auricles, usually about 30 or 40 times a minute. Since the ventricular beats cause the pulse, the patient may have a pulse of 30 or 40. This condition is the result of disease of the heart in which the auriculo-ventricular bundle is affected. It is characterized by a very slow pulse often associated with periodic fainting spells.

It can also be produced by digitalis and by mechanical measures in laboratory experiments.

Partial Heart Block

When some of the auricular contractions do reach the ventricles, the condition is known as **partial heart block**.

HEART STIMULANTS

Heart stimulants are drugs which increase the activity of the heart.

The following drugs are principally used as heart stimulants:

Digitalis, Strophanthus and members of the digitalis group
Caffeine
Camphor

Ammonia
Atropine
Strychnine
Epinephrine

Digitalis is the most reliable heart stimulant. Strophanthus and a few similar substances belong to the same group but they are seldom used.

DIGITALIS

Digitalis is a drug obtained from the leaves of the **Digitalis purpurea**, or **Purple foxglove**, which grows in most temperate climates, but the English leaves are the best. The leaves of the second year's growth are mostly used in making digitalis preparations, because they contain the largest amount of the active principles.

The active principles of digitalis are the glucosides: **digitoxin** and **digitalin**. Digitoxin is the most potent of all, and is largely responsible for the digitalis effects.

Appearance of the Patient

When digitalis is given to a patient suffering from failing compensation or myocardial insufficiency, all the symptoms disappear. Within a few days after its administration is begun, the patient breathes easier and the blue color of the skin disappears. The swelling of the extremities (oedema) gradually becomes lessened until it completely disappears. The pulse is stronger and slower and the patient passes more urine. When given to a patient in shock or collapse or in the course of an infectious disease the pulse becomes slower and stronger.

Action

Local Action: When injected hypodermically, digitalis is irritating to the tissues. It often causes inflammation and occasionally an abscess.

Internal Action

In the mouth: Digitalis has a bitter and unpleasant taste.

In the stomach: Many of the preparations of digitalis cause nausea and vomiting. This may result even after hypodermic administration.

In the intestines: Digitalis occasionally causes diarrhoea, because of the irritation of the mucous membrane of the intestines.

Action after Absorption

Digitalis preparations are very slowly absorbed into the blood from the intestines. It usually takes about 12 to 36 hours for the effects of the drug to develop. If given hypodermically, it enters the blood sooner, and the effects appear more rapidly.

Since digitalis is slowly absorbed, it produces prolonged effects. After absorption, digitalis affects principally the heart, the circulation and the kidneys.

Action on the Circulation

Digitalis makes the heart beat slower and stronger, consequently the pulse becomes slower and stronger. The slower rate prolongs the period of rest or diastole, during which the heart fills up with more blood. The stronger contraction or systole expels a larger quantity of blood from the heart and accelerates the flow in the blood vessels.

Secondary Effect

As a result of the improved heart action and the accelerated circulation, stagnation of the circulation in different organs of the body is relieved. In this way it relieves the symptoms of decompensation or failing heart action.

The shortness of breath (dyspnoea) and blue color of the skin (cyanosis) resulting from the stagnation of blood in the lungs, gradually disappear. The swelling of the legs due to oedema (accumulation of fluid) in the extremities, which is the result of circulatory stagnation in the extremities, is also relieved. The daily output of urine is increased because of the improvement of the circulation within the kidneys.

Mechanism of the Effect

The effect of digitalis is produced by the following mechanism:

1. The heart muscle is made to contract more rhythmically because its contractibility and tone is increased, thus increasing the systole.
2. The impulses along the Vagus nerve are accelerated, increasing the diastole or period of relaxation.
3. An artificial heart block is produced by lessening the conduction of impulses along the heart muscle fibers.
4. The circulation within the heart itself is improved because of the greater contraction and the longer period of rest which follows.

Action on the blood vessels: The doses of digitalis usually given to patients have no appreciable effect on the blood vessels. In laboratory experiments, however, the blood vessels are made narrower by the contraction of their muscle fibers.

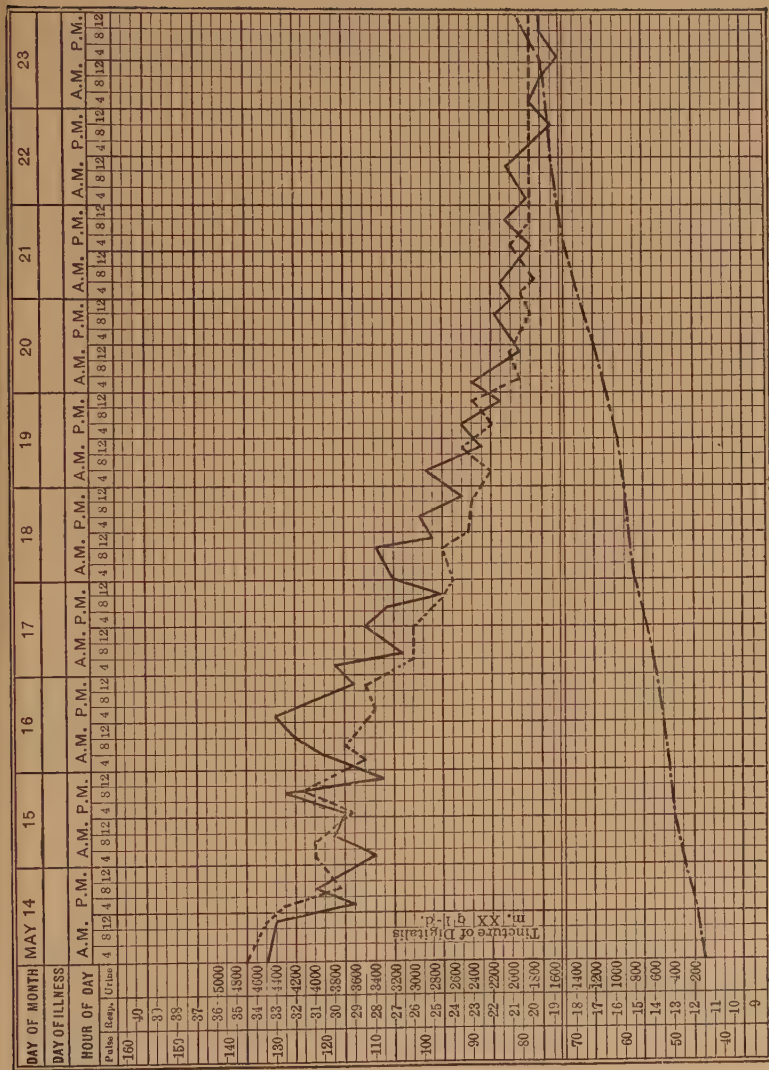


Chart of a case of Cardiac Decompensation in the Lenox Hill Hospital, showing the effect of digitalis on the pulse, respiration and daily output of urine.

Effect on blood pressure: The blood pressure (the pressure under which blood flows in the vessels) may not be affected at all by digitalis. Frequently, however, the blood pressure may be either raised or lowered, according to whether it was low or high as a result of the circulatory disturbance.

Action on the kidney: Digitalis increases the flow of urine very markedly; especially in cases where the tissues contain a great deal of fluid (oedema).

The increased secretion of urine is caused in two ways:

a. **By removing fluid from the tissues:** The freely moving current of blood prevents its stagnation in the veins and capillaries. The excessive fluid in the tissues then passes into these vessels (is absorbed). The quantity of fluid in the blood is thus increased and the excess is eliminated by the kidney, increasing the quantity of urine.

b. **By improving the circulation in the kidney:** Since the current of blood in the kidneys flows more vigorously, more fluid is brought, and oftener, for the kidney to excrete.

Poisonous Effects

Since digitalis is slowly absorbed, and excreted still more slowly, it does not cause acute poisonous symptoms.

Cumulative Digitalis Poisoning

Cumulative digitalis poisoning frequently results from its continued administration. Whenever it is necessary to administer digitalis for a long time, cumulative symptoms may be avoided by gradually reducing the frequency of the administration or by discontinuing the drug entirely, at intervals.

Symptoms

1. Persistent nausea and vomiting
2. Diarrhoea
3. Slow pulse; below 60, which may be irregular

This is the most important symptom of digitalis poisoning and should always be reported to the physician. It means that a condition of heart block has been produced.

In severe cases, or from an overdose given intravenously, in addition to the sudden onset of the foregoing symptoms there may be **weakness, headache, disturbance of vision and dizziness**. On the slightest exertion the pulse may become very rapid (130-150), weak and irregular, the breathing becomes slow and deep and the urine may be scanty.

Treatment

1. Stop the digitalis as soon as the pulse gets below 60 and is irregular. This is usually sufficient in most cases.
2. Keep the patient absolutely quiet.
3. Apply an ice bag or a hot water bag to the region of the heart.
4. Atropine, morphine, bromides and caffeine are the drugs usually given to relieve the condition.

Uses

Digitalis is given principally in two conditions:

1. In weakened heart action with evidence of circulatory stagnation where it acts almost as a specific.
2. In shock and collapse and in the course of infectious diseases to make the heart action and the pulse stronger and slower.

Administration

For a rapid effect, as in collapse, only some of the newer unofficial preparations are given. They act more quickly than other preparations and can be given hypodermically.

All preparations of digitalis should be given in a wineglassful of water slightly flavored. They should always be given between meals when the stomach contains little acid. The presence of excessive acid in the stomach lessens the absorption of digitalis preparations.

Digitalis preparations should be fresh and made from reliable English leaves. The failure to obtain results from digitalis is often due to unreliable preparations.

Preparations

Solid Preparations

Digitalis (Powdered leaves) (Digitalis)	0.03–0.12 Gm.	grs. $\frac{1}{2}$ –ii
Extract of Digitalis (Extractum Digitalis)	0.0075–0.03 Gm.	grs. $\frac{1}{8}$ – $\frac{1}{2}$

Fluid Preparations

Infusion of Digitalis (Infusum Digitalis)	4.0–16.0 c.c.	ʒi– $3\frac{1}{2}$
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The usual official infusion is a 1.5% solution, or one part of digitalis to 66 $\frac{2}{3}$ parts of water.

Many physicians order weaker infusions; such as 1–150, etc. The dose for such infusions is correspondingly larger.

Fluidextract of Digitalis (Fluidextractum Digitalis)	0.06-0.12 c.c.	m. i-ii
Tincture of Digitalis (Tinctura Digitalis)	0.3-1.0 c.c.	m. v-xv

This preparation keeps well and is perhaps the most reliable one.

New and Non-official Preparations

Many of the following preparations are used extensively and are very reliable. Some of them can be given hypodermically, because they produce effects rapidly.

Digalen (Liquor Digitoxin Solubilis)	0.6-2.0 c.c.	m. x-xxx
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Digalen is a solution containing digitoxin, the most active glucoside of digitalis, dissolved in a mixture of distilled water, glycerin and a very small amount of alcohol. It is given hypodermically, and produces its effects in one to two hours.

It is also given intravenously in doses of 0.3-1.0 c.c. (m. v-xv), producing effects in 15 minutes to a half hour.

Digalen Tablets: Each tablet contains the same amount of digitoxin that is contained in 0.5 c.c. (m. viii) of digalen.

Digipuratum or Digitan	0.1 Gm.	gr. $i\frac{1}{2}$
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These are tablets made from specially grown digitalis leaves from which many of the inactive substances have been removed. They are not so apt to cause nausea and vomiting. Each dose contains enough digitoxin to kill a frog weighing 30.0 Gms. by stopping its heart beat. The tablets are given four times a day, gradually reducing by one tablet a day until ten tablets are taken, then they are stopped. This allows the patient to eliminate the accumulated drugs, thus avoiding cumulative effects.

Digipuratum also comes in ampoules for hypodermic use, each containing 1.0 c.c., equivalent to 0.1 Gm. (gr. $i\frac{1}{2}$) of digipuratum.

Digitoxin	0.00025 Gm.	gr. $\frac{1}{2000}$
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This is not often used, as it cannot be dissolved easily and is very irritating.

Digipoten (tablets)	0.3-0.06 c.c.	gr. $\frac{1}{2}$ -i
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This is a mixture of the digitalis glucosides in soluble form.

Tincture No. 111 Digitalis	0.6 c.c.,	m.x
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This is a standardized fat free tincture of digitalis which is 50% stronger than the ordinary tincture. It contains 65% alcohol, the date of manufacture is stated on the bottle and the preparation is claimed to be active for one year. It comes in 30 c.c. (℥i) brown bottles with carbon dioxide gas added, to prevent deterioration. Digitalis contains small quantities of fat which is believed to cause nausea and vomiting. Fat free preparations are therefore less irritating to the stomach.

Digitol	0.3-1.0 c.c.	m. v-xv
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This is a fat free tincture of digitalis of the same strength as the ordinary tincture. It also comes in air tight ampoules each containing 30.0 c.c.

Digitolin 0.3–1.0 c.c. m. v–xv

This is a soluble preparation of digitoxin. It comes in glass ampoules each containing 1.0 c.c., and is used hypodermically or intravenously.

Digitalin, True 0.00025 Gm. gr. $\frac{1}{240}$

This is one of the glucosides of digitalis. It is not as active as digitoxin.

Digitalin, French 0.00025–0.002 Gm. gr. $\frac{1}{240}$ – $\frac{1}{30}$

This is a preparation containing digitalin.

Digitalin, German 0.001–0.002 Gm. gr. $\frac{1}{60}$ – $\frac{1}{30}$

Digitalin, Crude

These are mixtures of digitalis glucosides, each made by a different process. The former is made from the seeds.

STROPHANTHUS

Strophanthus is a drug obtained from the ripe seeds of the *Strophanthus hispidus*, a climbing shrub of Africa. It has been used for a long time by the natives of that country, as an arrow poison under various names; such as kombé, inée, ouaye, or pahouius poison. Its active principle is a glucoside, **strophanthin**.

Action

Strophanthus acts like digitalis but its effects differ somewhat as follows:

1. When given by mouth it may not be absorbed; therefore its effects are unreliable.
2. It increases the contraction of heart muscle more than digitalis does, and it raises the blood pressure.
3. It is much more poisonous than digitalis; the poisonous effects appear more suddenly and are more severe.
4. It frequently causes profuse diarrhoea.
5. It does not act as a diuretic.

Its active principles, however, are very useful for intravenous and intramuscular use.

Preparations

Tincture of Strophanthus 0.3–1.0 c.c. m. v–xv
(Tinctura Strophanti)

Strophantin 0.0003–0.001 Gm. gr. $\frac{1}{200}$ – $\frac{1}{80}$

This is the active glucoside.

Ouabain

(Crystallized Strophantin) 0.003–0.025 gm. gr. $\frac{1}{20}$ – $\frac{2}{5}$

This is given intravenously and intramuscularly, in doses of gr. $\frac{1}{130}$, well diluted. It is obtained from a species of *Strophanthus* and is more active than the ordinary strophantin.

SQUILLS (SCILLA)

Squills is obtained from the bulb of the *Unginea maritima* or *Squills maritima*, the sea onion, a plant growing in the southern part of Europe. The outer coat of the bulb is removed and the bulb is then cut into slices. From these slices the preparations are made. The active principle is a glucoside, *scillain*.

Action: Squills acts like digitalis but it is not as reliable. It is more rapidly absorbed, however, and after absorption it especially increases the secretions of all mucous membranes. It is therefore, frequently used to loosen and increase the cough, especially in old people. In such patients the mild improvement of the heart action and the increased secretion of urine benefit the general health as well.

Preparations

Syrup of Squills (<i>Syrupus Scillae</i>)	2.0-4.0 c.c.	$3\frac{1}{2}$ -i
Compound Syrup of Squills (<i>Syrupus Scillae Compositus</i>)	0.6-2.0 c.c.	m. x-xxx

This contains squills, senega and tartar emetic.

Guy's, Fothergill's or Neumayer's Pill

This contains calomel, squills, digitalis (powdered leaves); of each 0.06 Gm. (gr. i). It is an excellent diuretic. Squills is usually given in pill form for diuretic action. As an expectorant the syrup is usually given. It is also contained in Stokes' expectorant.

CONVALLARIA

Convallaria is obtained from the roots and underground stems of *Convallaria majalis* or lily of the valley. Its active principle is a glucoside, *convallamarin*.

Convallaria acts like digitalis, but is not as reliable. It is more poisonous than digitalis, however.

Fluidextract of Convallaria (<i>Fluidextractum Convallariae</i>)	0.3-1.0 c.c.	m. v-xv
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APOCYNUM

Apocynum or Canadian hemp is obtained from the root of the *Apocynum cannabinum*, Canadian hemp or milkweed. Its active principles are *cymarin*, a neutral substance which acts like strophantin, and two glucosides, *apocynin* and *apocynein*. It acts like digitalis but is unreliable and very expensive. It makes the heart beat slower and stronger and increases the secretion of the urine. It is not so apt to cause cumulative symptoms.

Preparations

Fluidextract of Apocynum (<i>Fluidextractum Apocyni</i>)	0.3-2.0 c.c.	m. v-xxx
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Cymarin By mouth, 0.0003 Gm., (gr. $\frac{1}{2000}$) three or four times a day.

This is a substance obtained from *apocynum*. It is used like strophantin. It is not absorbed so readily from the gastro-intestinal tract. It comes in tablets and in ampoules. It is given intramuscularly or intravenously in doses of 0.0005-0.001 Gm., (gr. $\frac{1}{200}$ - $\frac{1}{800}$).

QUINIDINE

Quinidine is one of the active alkaloids of Cinchona. It was formerly used as a substitute for quinine, because it was cheaper, but it has recently been found to be useful as a heart stimulant.

Action

Quinidine acts on the heart, lessening auricular fibrillation (see page 216). It lessens the irritability of the heart and establishes the normal rhythm of the heart muscle contractions, **changing a rapid irregular pulse to a slow, regular one.** At times the heart beats regularly but remains rapid. The effect is obtained in from one to three days and may last a few days to several months. It is especially valuable when the auricular fibrillation and rapid heart action occur in periodic attacks or when the condition is not of long standing. It is not so effective when the patient has been suffering with myocardial insufficiency (weakened heart action) for a long time.

Poisonous Symptoms

In some patients the following poisonous symptoms may result, even after the heart is beating normally and fibrillation is relieved.

1. Nausea and vomiting.
2. Palpitation of the heart, fainting and flushing of the face.
3. Headache and convulsions.

Sudden death has been reported.

If these symptoms occur the drug should be stopped.

Administration

Quinidine is given in the form of **quinidine sulphate** in doses of 0.2 Gm. (grs. iii), which is repeated in two hours. If the patient shows no poisonous symptoms it is given in doses of 0.2-0.4 Gm. (grs. iii-vi), three to five times a day for one to three days. The maximum dose is 1.0-2.0 Gms. (grs. xv-xxx).

CAMPHOR (CAMPHORA)

Camphor is obtained from the *Laurus camphora* or *Cinnamomum camphora*, an evergreen tree growing in China and Japan. It has been used by the Chinese for many centuries.

It is made by chopping up the root, stems and branches of the tree into fine pieces and boiling them in water. The volatile oil which the plant contains then rises to the top. When the fluid is allowed to cool, part of the oil evaporates and leaves a thick

film or stearoptene, which is camphor. This is then skimmed off, purified and used as a drug. Camphor is also made chemically.

Action

Local action : Applied to the skin, camphor causes redness and a feeling of warmth. It relieves pain at the spot where it is applied, and is slightly antiseptic.

Internal Action

In the mouth : Camphor has a hot, bitter taste.

In the stomach : It causes a feeling of warmth, checks the formation, and hastens the expulsion of gas (carminative action).

In the intestines : It often checks diarrhoea and aids in the expulsion of gas.

Action after Absorption

Camphor is absorbed from the stomach in a few hours. After absorption it affects principally the heart, the brain and the secretions.

Action on the heart : Camphor may make the heart beat stronger. The rate may be faster or slower. Frequently there is no effect on the heart at all.

The blood vessels are widened, however, and the pulse may have a bounding quality while the rate may be slow or fast.

Action on the respiration : Camphor makes the patient breathe faster and deeper. This action is not always marked.

Action on the brain : In the doses that are usually given, camphor makes the patient feel calm and quiet, though somewhat exhilarated. In larger doses the action of the brain is increased. The patient then becomes more active and more talkative.

In poisonous doses, the action of the entire brain is increased, the brain sending out so many impulses, for motion, speech, etc., that convulsions and delirium may occur.

Action on secretions : Camphor slightly increases the secretions, especially the sweat and mucus.

Excretion

Part of the camphor is used up by the tissues of the body, the rest is eliminated in a few hours in the urine, sweat and faeces.

Poisonous Effects

Overdoses of camphor produce the following symptoms, though they are rarely fatal:

1. Burning pain in the stomach.
2. Headache, dizziness, delirium and convulsions.
3. Collapse: weak, small pulse, rapid or slow, pale, cold, moist skin.

These symptoms disappear when the drug is stopped. Bromides or whiskey are sometimes necessary to relieve the symptoms.

Uses

Preparations of camphor such as the liniment, are used to relieve pain, in sprains or muscular rheumatism.

It is used as a heart stimulant, and often to lessen nervousness.

Camphor oil is given in pneumonia by repeated intramuscular injections of 10 c.c. ($3\text{ii}\frac{1}{2}$) doses. This treatment is based upon the fact that camphor checks the growth of the Pneumococcus, the bacterium which causes pneumonia. It is then supposed to act as a specific in pneumonia, and at the same time to strengthen the heart action.

Preparations

Solid Preparations

Camphor (Camphora)	0.1–0.6 Gm.	grs. $\text{i}\frac{1}{2}$ –x
Monobromated Camphor (Camphora Monobromata)	0.12–1.0 Gm.	grs. ii–xv

This is occasionally used to relieve nervousness, hysteria and sexual excitement.

Camphor Oil (Oleum Camphorae)	0.3–0.6 c.c.	m. v–x
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This is the crude oil itself and is rarely used.

Camphor Liniment or Camphorated Oil (Linimentum Camphorae)	2.0 c.c.	m. xxx
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This is a 20% solution of camphor in cottonseed oil. It is used locally to relieve pain. It also comes in ampoules.

It is extensively used, however, for hypodermic use as a heart stimulant; and in doses of 10 c.c. in the treatment of pneumonia. It should always be injected deeply into the muscles.

Camphor Water and Spirit of Camphor are preparations used as carminatives (see page 160).

AMMONIUM

Ammonium is a solution of ammonia gas in water. It is a strong alkali formed by the combination of one part of nitrogen gas and three parts of hydrogen gas. There are two types of ammonia salts, those which liberate ammonia and those which act as salts. The latter are used principally as expectorants.

Action

Local Action: A weak solution of ammonia makes the skin soft and slippery, as if it were covered with soap. Stronger solutions kept in contact with the skin and prevented from evaporating may form blisters or destroy the skin.

In the stomach it neutralizes the acid and checks the formation of gas.

When inhaled, ammonia is very irritating and causes excessive secretion of mucus from the nose and bronchi, and a flow of tears.

Ammonia affects principally the heart and respiration. When given by inhalation or by mouth, it causes a temporary strengthening of the heart action with a rapid strong pulse, and makes the breathing somewhat more rapid and deeper. These effects result from the local irritation of the mucous membranes of the nose, throat or lungs when inhaled, or from the irritation of the mucous membrane of the stomach when given by mouth.

Ammonia is eliminated as urea, a normal ingredient of the urine. It is also excreted by the excessive secretion of the mucous membranes.

Poisonous symptoms may result from strong solutions of ammonia. The symptoms are those of alkali poisoning (see page 148).

Uses

Ammonia is used for the following conditions:

1. As a heart stimulant for temporary effect, for example, in fainting.
2. In the form of liniments, to relieve pain.
3. To neutralize excessive acid in the stomach.
4. To check the formation of gas in the stomach.
5. To increase the cough and expectoration.

Preparations

Fluid Preparations

Aromatic Spirit of Ammonia (Spiritus Ammoniae Aromaticus)	2.0-4.0 c.c.	3½-i
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This contains ammonia water and 4% of ammonium carbonate, together with the oil of nutmeg, oil of lemon and oil of lavender.

It is used principally to overcome fainting, as a carminative, and to relieve nausea.

Solution of Ammonium Acetate (Liquor Ammonii Acetatis)	4.0-16.0 c.c.	3i-iv
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(Spirit of Mindererus)

This is used principally to increase sweating (diaphoretic action) and to increase the flow of urine (diuretic action).

OTHER HEART STIMULANTS

The following drugs are used extensively as heart stimulants, although this is not their principal effect.

Caffeine

Caffeine is used in cases of collapse to improve the character of the pulse and breathing. It causes an evanescent rapid, perhaps stronger, pulse. This is the result of the action on the brain and

medulla. The greater number of impulses sent from the vaso constrictor center of the medulla cause slight contractions of the muscle fibers in the walls of the small blood vessels which make the blood vessels narrower and thus temporarily improve the character of the pulse.

Alcohol

Alcoholic liquors make the heart **beat stronger and faster**. Because the blood vessels are widened (dilated), **the pulse has a bounding quality**.

The effects last only for a very short time, however, and are the result of the local irritation of the mucous membrane in the mouth or at the site of injection. For hypodermic use, whiskey is the preparation commonly used.

For other actions and preparations, see page 293.

Atropine

Atropine makes the heart beat stronger and faster. It paralyzes the nerve endings in the heart, of the Vagus or inhibitory nerves, which carry impulses to make the heart beat slower. When these impulses are cut off the heart beats stronger and faster; consequently **the pulse, after atropine, is stronger and faster**.

For other actions and preparations, see page 343.

Strychnine

Strychnine makes the heart beat slower and stronger when given in large doses. It causes the medulla of the brain to send impulses along the Vagus or inhibitory nerves, to make the heart beat slower. It also contracts the blood vessels, and by thus offering greater resistance to the heart, makes the heart beat stronger. **The pulse is therefore slower and stronger after strychnine**.

For other actions and preparations, see page 267.

VASO CONSTRICTORS

(Drugs which Contract the Blood Vessels)

EPINEPHRINE (ADRENALIN)

Epinephrine or adrenalin is a liquid extract made from the medulla of the suprarenal or adrenal gland of the sheep or ox. This gland is a small pyramidal gland situated directly on top of the upper pole of each kidney. The gland is divided into two portions, an inner portion or medulla, and an outer portion or cortex. Epinephrine is made only from the medulla. It is an alkaloid-like substance and is also made artificially. A dried extract is also made from the cortical portion of the gland.

Appearance of the Patient

After an intravenous or hypodermic injection of epinephrine, the following effects are noticed within 15 or 20 minutes:

The skin becomes pale, all the visible mucous membranes, such as the lips and conjunctiva, become pale and blanched and the pupils are dilated.

The pulse is slow, strong, and tense and the blood pressure is greatly increased. The breathing is somewhat deeper. Some patients become very nervous, they get a rapid pulse and a throbbing sensation in the heart. The effects wear off in an hour.

If epinephrine is given during an attack of asthma the shortness of breath is relieved.

ACTION

Local action: Applied to the skin, epinephrine has no effect. If applied to a bleeding surface, it checks the bleeding by contracting the blood vessels. **On mucous membranes:** It makes the mucous membranes pale by contraction of the underlying blood vessels. This is followed by dilatation or widening of the blood vessels. If applied to the **conjunctiva of the eye**, epinephrine makes it pale, widens the eyelids, and dilates the pupils. **In the nose:** It makes the mucous membrane pale and contracts the blood vessels and thereby relieves nasal obstruction.

Internal Action

In the mouth: Epinephrine contracts the mucous membrane, from which it may be slightly absorbed.

Action after Absorption

When given by mouth it is not absorbed. When given intravenously, the effects appear in about five minutes. When given intramuscularly or hypodermically, the effects appear within fifteen minutes to a half hour.

After absorption, epinephrine affects principally the blood vessels, the heart, the involuntary muscles, the pupils and secretory glands.

Action on the blood vessels: This is the most important effect of epinephrine. It makes all the small blood vessels, especially the small arteries and capillaries, narrower by contraction of the small muscle fibers in their walls.

The narrower blood vessels offer a greater resistance for the heart, raising the blood pressure (the pressure of the blood in

the blood vessels), thus increasing the force of its contractions; but the effect does not last. The blood vessels in the abdomen are contracted most of all, those in the brain and lungs least. The coronary vessels in the heart are dilated, however.

Action on the heart: Epinephrine makes the heart beat slower and stronger, producing a slow, strong, tense pulse. In some patients the pulse is rapid.

Action on involuntary muscles: It increases the contractions of the involuntary muscles of the uterus and its blood vessels.

The involuntary muscles of the **stomach** and **intestines** are **relaxed**; though the blood vessels in their walls are contracted.

Action on the Pupil: The pupil of the eye is widened (dilated) by contraction of the radial fibers of the iris, the colored part of the eye.

Action on the secretory glands: The secretions of all the secretory glands, except the sweat glands and the pancreas, are increased by epinephrine. This effect is produced by making the nerve endings in the glands more sensitive to stimuli. As a result of this action, they receive more impulses, which make the glands secrete more profusely.

Epinephrine therefore increases the flow of saliva, mucus in the mouth, tears and bile.

The secretion of the sweat and pancreatic juice is not increased. It often causes sugar in the urine (glycosuria).

The effect of epinephrine wears off very quickly; usually in about a half to one hour.

Excretion

Most of the epinephrine is destroyed in the body, while the rest is eliminated in the urine in about an hour or two.

Poisonous Effects

Overdoses of epinephrine cause the following symptoms:

1. Slow, irregular pulse. (In some patients the pulse is very rapid.)
2. Pale, blanched skin.
3. Dilated pupils.
4. Throbbing sensation in the heart.
5. Tremors.
6. Collapse: Pale, cold, moist skin, slow and shallow breathing.

A single overdose may cause such profound collapse that death may result.

Uses

Epinephrine is used for the following conditions:

1. **To check bleeding** by contracting the bleeding vessels. It is only of value in bleeding from the small blood vessels. The bleeding may start up again, however, when the effect of the drug wears off, because after the blood vessels are contracted, they soon dilate again.

In bleeding from the nose, stomach, intestines, uterus or bladder, epinephrine is very valuable, if it can be applied to the bleeding spot without the necessity of an elaborate surgical procedure.

2. To relieve an attack of asthma.

3. **As a heart stimulant**, especially where a rapid effect is desired. The effect soon wears off, however.

4. Epinephrine is often used together with cocaine, procaine or its derivatives. It contracts the blood vessels, lessening the absorption of the cocaine, which is then less apt to cause poisonous effects.

5. In the treatment of Addison's disease (tuberculosis or cancer of the adrenal glands), it is given to supply the absent secretion of the adrenal glands.

6. Epinephrine is also given hypodermically to lessen the painful spasm of an ulcer in the stomach.

7. It has recently been used, with success, to resuscitate newly born infants by directly injecting it into the heart.

8. It is also injected hypodermically as a test for hyperthyroidism, a positive test consisting of a rapid pulse, rise in blood pressure and tremors.

9. It is also given by injection to relieve urticaria or hives.

Administration

Epinephrine is given intravenously, intramuscularly, or hypodermically. When it is given intravenously, it must be injected very slowly, to avoid poisonous effects. It is sometimes given by dropping under the tongue. For resuscitation, when the patient is near death, it is injected directly into the heart.

For local effect, it is used in 1-15000 to 1-1000 solutions, preferably in oil.

Preparations

Dried Suprarenal Gland	0.06-0.3 Gm.	grs. i-v
(Glandulae Suprarenales Siccae)		

This is the powdered dried suprarenal glands of the sheep or ox.

Epinephrine Chloride	0.3-1.0 c.c.	m. v-xv
(Liquor Epinephrine Hydrochloride or Adrenalin Chloride Solution)		

This is a 1-1000 solution of epinephrine or adrenalin chloride, the active principle of the suprarenal glands, in normal salt solution.

Adrenalin Inhalant

This is a 1-1000 solution of adrenalin chloride in oil.

Adrenalin Ointment

This is an ointment of adrenalin chloride 1-1000 in strength.

Adrenalin Suppositories

This is a 1-1000 solution of adrenalin chloride in cocoa butter.

Adrenalin Tablets

Each tablet contains 0.001 Gm. (gr. $\frac{3}{2000}$) of adrenalin borate. When dissolved in 1.0 c.c. (m. xv) of water, it makes a 1-1000 solution.

Adrenalin is a patented name for epinephrine. There are other preparations of epinephrine, made by other firms under various names, such as:

Adnephrin	} The preparations of these are the same as those of adrenalin.
Suprarenalin	
Suprarenin	
Supracapsulin	

L. Suprarenin Synthetic Bitartrate is an artificial preparation of adrenalin.

PITUITARY LIQUID (PITUITRIN)

Pituitary liquid or pituitrin is an extract made from the posterior lobe of the pituitary gland. It contracts involuntary muscles. It makes the heart beat stronger and slower. It is occasionally used as a heart stimulant given hypodermically in doses of 1.0 c.c. (m. xv) (see page 397).

ERGOTOXINE

This is the active principle of Ergot. It contracts the blood vessels and increases the blood pressure.

TABLE OF CIRCULATORY STIMULANTS

Drugs acting rapidly. Suitable for immediate effect	Drugs acting slowly. Suitable for continuous effect.	Drugs causing a rapid pulse	Drugs causing a slow pulse	Drugs whose effects wear off quickly	Drugs which raise the blood pressure
Caffeine Strychnine Atropine Camphor Epinephrine Pituitrin Ammonia Alcohol Digalen Digipuratum (ampoules) Strophantin	Digitalis Strophanthus Quinidine Squills Convallaria Apocynum	Caffeine Atropine Ammonium Alcohol Camphor (sometimes)	Digitalis Strophanthus Squills Convallaria Apocynum Quinidine Strychnine Epinephrine Camphor (sometimes) Cymarin	Caffeine Epinephrine Ammonia Alcohol Pituitrin	Epinephrine Pituitrin Ergotoxine Strophanthus

CHAPTER XVII

CIRCULATORY DEPRESSANTS

HEART DEPRESSANTS

Heart depressants are drugs which lessen the activity of the heart. The substances principally used for this purpose are the following:

Aconite

Veratrum Viride

Coal Tar preparations such as:

Aspirin

Phenacetine

Acetanilid, etc.

The most important effects of the following group of drugs is to lessen the action of the heart. (See page 214 for heart depression.)

ACONITE (MONK'S HOOD OR WOLFSBANE)

Aconite is obtained from the root of **Aconitum napellus**, monk's hood or wolfsbane, a perennial plant growing in the mountainous regions of Europe and Asia. The root often resembles horse-radish in appearance. The active principle of aconite is the alkaloid, **aconitine**.

Appearance of the Patient

When an average dose of aconite is given, the patient's mouth and throat feel warm, and he often complains of slight numbness and tingling of the lips, tongue and throat, and sometimes in the extremities. The pulse is slower and somewhat weaker, and the breathing is usually slow and shallow. The temperature is lowered and the patient often feels quite weak.

Action

Applied locally to the skin or mucous membranes, aconite produces a tingling sensation followed by numbness and a slight loss of sensation.

When given by mouth it is absorbed in a half hour and then it affects principally the heart, the blood pressure and the nerve endings, producing the following effects:

1. **On the heart:** It makes the heart beat slower and weaker, producing a slow, soft pulse.

2. It lowers the blood pressure.

3. **On the respiration:** Moderate doses may increase the respiration and large doses make the breathing slower and more labored.

4. **Action on the nerve endings:** When taken internally, or when applied locally, aconite makes the sensory nerve endings of the skin and mucous membranes more sensitive at first, and later paralyzes them. This produces the tingling and prickling sensations, followed by numbness, which are so characteristic of aconite.

The muscular weakness produced by aconite in large doses is due to its effect on the nerve endings in the muscles.

Action on the secretory glands: Aconite increases the secretion of sweat and saliva, by making the nerve endings in the mouth and skin more sensitive, thus reflexly increasing the secretions.

Effects on temperature: It reduces temperature by increasing the elimination of heat.

Excretion

Aconite is eliminated from the body in about three or four hours after it is given, mainly by the urine.

Poisonous Effects

Aconite is one of the few poisons which cause death very rapidly. If a sufficiently large dose is taken, the patient may die immediately, from sudden paralysis of the heart. Usually, however, the symptoms appear very rapidly and the patient dies in about three or four hours.

Symptoms

The first and characteristic symptom is tingling and prickling sensation on the lips, mouth and throat, and a smarting, tingling feeling in the skin of the extremities, soon followed by numbness. Later this sensation passes over the entire body.

2. Profuse flow of saliva, nausea and vomiting.

3. Great muscular weakness.

4. Slow, irregular, weak pulse.

5. Slow, shallow, difficult, irregular breathing.

6. Collapse (cold, moist skin; anxious face; protruding eyeballs with dilated pupils; rapid, thready, very weak pulse).

7. Often there are convulsions and unconsciousness just before death. Usually, however, consciousness remains to the end. Death results from paralysis of the respiration.

Treatment

To save a patient from aconite poisoning, quick action is necessary, as death results very rapidly.

1. The stomach is usually washed out.

2. **Atropine is given as an antidote.**

This prevents the slow weak heart action, by paralyzing the nerve endings in the heart, of the Vagus nerve, and it also makes the breathing faster and deeper.

3. Keep the patient absolutely quiet, flat on his back.

4. Give artificial respiration.

5. Heart stimulants such as caffeine, whiskey, ammonia, are usually given.

Uses

Aconite is now rarely used. It is applied locally to relieve pain; for example, in toothache. It was principally given to reduce fever in acute infectious diseases.

Preparations

Fluidextract of Aconite (Fluidextractum Aconiti)	0.06-0.12 c.c.	m. i-ii
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Tincture of Aconite (Tinctura Aconiti)	0.06-0.6 c.c.	m. i-x
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This is 10% in strength and is the preparation commonly used.

Aconitine (Aconitina)	0.00015-0.0006 Gm.	gr. $\frac{1}{400}$ - $\frac{1}{100}$
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This is the active alkaloid.

STAPHISAGRIA (STAVESACRE OR DELPHINIUM)

Staphisagria or delphinium is obtained from the dried ripe seeds of *Delphinium staphisagria* or stavesacre. Its active principle is an alkaloid, delphinine, which produces the same effects as aconitine.

Delphinium is used in the form of a tincture or ointment to destroy parasites, such as lice.

VERATRUM (AMERICAN HELLEBORE)

Veratrum is obtained from the root and underground stems of the *Veratrum viride*, or green hellebore, a plant which grows in swampy places in the northern part of the United States. It is commonly known as American or swamp hellebore, or Indian poke.

The active principles of veratrum are the alkaloids, **cevadine** and **veratrine**. They are very closely related to aconitine chemically, and produce very similar effects.

ACTION

The following are the principal effects of veratrum; they resemble those of aconite but they differ in several instances:

1. Locally, veratrum is very irritating to the skin and mucous membranes but is soon followed by a local soothing effect. It causes profuse sneezing and coughing when inhaled.

2. It frequently causes nausea and vomiting.

3. It makes the heart beat slower and weaker, by increasing the impulses sent to it through the Vagus nerves, thus causing a slow soft pulse.

4. It lowers the blood pressure.

5. It slightly increases the contraction of muscles but it markedly prolongs the period of relaxation. This is a very characteristic effect of veratrum and is often spoken of as "veratrine effect."

Veratrum is used principally to lower blood pressure in eclampsia, a condition of poisoning occurring in pregnancy.

Preparations

Fluidextract of Veratrum (Fluidextractum Veratri)	0.06–0.3 c.c.	m. i–v
Tincture of Veratrum (Tinctura Veratri)	0.3–1.0 c.c.	m. v–xv

Veratrine

This is a mixture of all the alkaloids found in **Veratrum sabadilla**, or **Asagraea officinalis**, a Mexican plant known as cevadilla. It produces the same effects as veratrum. It is used principally to relieve pain in neuralgia, rheumatism, etc., in a 4% ointment and a 2% oleate.

VASO-DILATORS

Vaso dilators are drugs which dilate the blood vessels. The drugs principally used for this purpose are the **nitrites**.

THE NITRITES

The nitrites are salts formed by the combination of nitrous acid with an alkali, or an organic substance such as alcohol, as amylic alcohol. The most important compounds formed in this way are **amyl nitrite** and **nitroglycerine**. Amyl nitrite produces rapid effects which soon pass off, and nitroglycerine produces slower effects which are more lasting.

Appearance of the Patient

About three to five minutes after an average dose of amyl nitrite is inhaled, the face becomes flushed, and sometimes the skin all over the body as well. The patient complains of fullness

and throbbing in the head, and often of severe headache. The pulse is rapid, soft and bounding, the breathing is rapid and somewhat deeper and the blood pressure is lowered. These effects last for about ten to fifteen minutes.

When nitroglycerine or any of the other nitrites are given there is a gradual reduction in blood pressure, the pulse becomes softer, somewhat more bounding, the patient may complain of slight headache and fullness in the head. The effect lasts for about an hour. When sodium nitrite or the newer preparations are given the effect lasts for several hours.

ACTION

In the mouth: Nitroglycerine has a pungent taste.

In the stomach: All the nitrites, with the exception of nitroglycerine, may cause nausea and vomiting.

Action after Absorption

The nitrites are very rapidly absorbed into the blood, through the lining membrane of the stomach. After absorption, they affect principally the blood vessels, the respiration and the kidneys.

Action on the circulation: The nitrites do not affect the heart directly, but by means of their action on the blood vessels.

Action on the blood vessels: The nitrites relax the muscle fibers in the walls of the small blood vessels. This lowers the blood pressure and makes the heart beat faster. Consequently the pulse is rapid, soft and bounding.

The relaxed and widened blood vessels ease the action of the heart, when it is overworking because of increased blood pressure, or spasmodic contractions of the blood vessels.

The blood vessels of the abdomen and head are more affected than those of the extremities.

Action on the respiration: The nitrites make the breathing faster and deeper.

Action on the nervous system: The nitrites do not affect the nervous system directly. The headache, the fullness in the head and the occasional dizziness, are due to the dilated blood vessels in the brain, which then contains more blood (congestion), as a result of which these sensations are produced.

Effect on temperature: The temperature may be somewhat lowered because the blood vessels in the skin are dilated, thus increasing the elimination of heat.

Action on the kidneys : The flow of urine is often increased by the nitrites, when the kidneys do not secrete a sufficient amount of urine because of high blood pressure. The improved circulation of blood in the kidneys as a result of the widened blood vessels increases the secretion of urine.

Excretion

The nitrites are excreted by the urine, usually in about one or two hours.

Poisonous Effects

Poisonous symptoms usually occur suddenly from the inhalation of an overdose of amyl nitrite. After prolonged administration of the other nitrites the same symptoms occur but more gradually.

Symptoms

1. Flushing of the face and neck.
2. Intense throbbing headache (a feeling of a tight band around the head or as if the "head were coming off").

These symptoms frequently occur from an ordinary dose of amyl nitrite but soon pass off. Occasionally from a single dose of amyl nitrite, and from continued use of other nitrites, the following symptoms may also occur:

3. Fainting sensation.
4. Dizziness.
5. Dilated pupils.
6. Cyanosis and cold extremities.
7. Collapse, weak pulse.

The symptoms usually improve when the patient is lying down or when the drug is stopped.

Uses

The nitrites are given principally in repeated doses for a long time, in the following conditions:

1. **Arteriosclerosis**, or hardening of the arteries.

They are given to relax the muscle fibers of the arteries. In many cases the nitrites produce no effect, as the muscle fibers have been replaced by fibrous or connective tissue.

2. To reduce blood pressure.
3. To relax the contractions of the involuntary muscles in the bronchi, to relieve an attack of asthma.

4. To prevent the attacks of angina pectoris by keeping the muscles of the coronary blood vessels of the heart relaxed.

5. To increase the flow of urine in nephritis.

Administration

The nitrites should be given in a wineglassful of milk after meals. If tablets are ordered, they should be dissolved in the milk.

Amyl nitrite is usually given by inhalation. It comes in small glass "pearls," each containing about 0.2-0.3 c.c. (m. iii-v) of amyl nitrite, which are broken in a handkerchief and then applied to the nose of the patient. The handkerchief should be withdrawn as soon as the effects are produced. Amyl nitrite is occasionally given hypodermically. It is also given by mouth; about 0.2-0.3 c.c. (m. iii-v) dropped on a piece of sugar; but the effects then appear very slowly.

Preparations

Amyl Nitrite	0.12-0.3 c.c.	m. ii-v
(Amylis Nitris)		

This should always be fresh as it decomposes very easily.

Uses

Amyl nitrite is used for the following effects:

1. To relieve an attack of "angina pectoris," a disease characterized by attacks of severe pain around the heart, and shooting pains radiating into the left arm. This disease is due to the spasmodic contractions of the muscle wall of the coronary arteries in the heart (the vessels which supply the heart muscle with blood). Amyl nitrite relieves these attacks by relaxing the spasms of these blood vessels.

2. To relieve an attack of bronchial asthma; by relaxing the spasm of the involuntary muscles in the walls of the bronchi.

Preparations

Spirits of Glyceryl Trinitrate	0.03-0.2 c.c.	m. $\frac{1}{2}$ -iii
(Spiritus Glycerylis Nitratis)		

Nitroglycerine or Spirit of Glonoin

Nitroglycerine, or spirit of glonoin, is a colorless, oily liquid which has an odor and taste like alcohol. It is a 1% alcoholic solution of nitroglycerine. It should always be fresh, as it decomposes very easily. It should be kept cool, as it may explode when exposed to heat. Nitroglycerine combined with porous silica forms dynamite. Preparations of nitroglycerine should be very carefully handled, as they are apt to explode when dropped on the floor, when heated, or when rubbed vigorously. If they are accidentally spilled, they should be destroyed immediately, by pouring potassium hydroxide solution over them.

Tablets of Nitroglycerine	0.0006 Gm.	gr. $\frac{1}{100}$
(Tabellae Trinitrini)	1 to 2 tablets are given at a time.	

These are not as efficient as a solution of the drug, and they decompose very easily.

Sodium Nitrite	0.06–0.12 Gm.	grs. i–ii
(Sodii Nitris)		

This is given in solution or in tablets.

Potassium Nitrite	0.06–0.5 Gm.	grs. i–viii
(Potassii Nitris)		

Sodium and potassium nitrites are salts formed by the combination of sodium or potassium, with nitrous acid.

They produce the same effects as amyl nitrite or nitroglycerine, with the following variations:

1. Their effects appear very slowly, usually in about a half hour, but they last for several hours.

2. They often cause nausea, belching of gas, and pain in the stomach, and occasionally diarrhoea.

3. They do not cause as much headache, or flushing of the face, as amyl nitrite or nitroglycerine does.

The nitrite of sodium or potassium is suitable for continued use, to lower the blood pressure.

Spirit of Ethyl Nitrite	1.0–4.0 c.c.	℥ ¼–i
(Spiritus Aethylis Nitritis or Spiritus Aetheris Nitrosi)		

Spirit of Nitrous Ether or Sweet Spirit of Niter

Sweet spirit of niter is used to increase the sweat and thereby to reduce fever, especially in children. It is given in small doses, well diluted; and the patient should be kept in bed, warmly covered. If the skin is kept cool, it increases the flow of urine.

New and Non-official Preparations of the Nitrites

Erythrol Tetranitrate	0.03–0.06 Gm.	gr. ½–i
(Tetranitrol)		

Mannitol Hexanitrate	0.03–0.06 Gm.	gr. ½–i
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These preparations are given in tablets, because they are explosive in fluid form. They act more slowly than the other nitrites, the effect lasting three or four hours.

PEROGEN BATH SALTS (OXYGEN BATH SALTS)

This consists of sodium perborate and a catalytic substance. It is dissolved in a bathtubful of water when it liberates oxygen gas. These baths are used to lower blood pressure, to quiet the patient and produce sleep.

PART V—DRUGS ACTING ON THE RESPIRATORY SYSTEM

CHAPTER XVIII

DRUGS ACTING ON THE RESPIRATORY ORGANS

The Respiration

Breathing is an act whereby the lungs regularly inhale and exhale air about 18–20 times a minute. The mechanism of breathing consists of rhythmical alternate expansions and contractions of the lungs.

Respiration consists of two phases:

1. **Inspiration**

2. **Expiration**

The **inspiration** is the period during which the lung inhales air. It is caused by the downward movement of the diaphragm, and the separation of the ribs. This makes the chest wider, so that the lungs expand and inhale air.

The inspired air, which fills up the air sacs of the lungs, contains oxygen. This oxygen enters the blood, by passing through the walls of the air sacs into the capillaries of the lungs. It is then carried to the tissues and organs of the body by the circulation of the blood.

The **expiration** is the period when the lungs exhale air. This is caused by the contraction of the diaphragm, which then moves upward, by the contractions of the intercostal muscles (the small muscles between the ribs) and by the elasticity of the lung tissue. As a result of the contractions of these muscles, the chest becomes narrower, the lungs therefore contract and expel the air which they contain. The expired air contains carbon dioxide gas, and other waste products which have been brought to the lungs by the impure blood from the various tissues and organs of the body.

Breathing is an automatic act; that is, it occurs independently of all the influences produced by the other activities of the body.

The most important part of the act of breathing is the action of the diaphragm, a flat dome-shaped muscle separating the chest from the abdomen. The contractions of this muscle are controlled by impulses sent from a spot of gray matter in the medulla of the brain, along two nerves, the Phrenic nerves, which go to this muscle. This spot of gray matter is called the respiratory center. It is often called the vital center, because when it ceases to send impulses for breathing, death ensues. Death by hanging, or by the garotte (a method for executing criminals in Spain), is caused by the destruction of the respiratory center in the medulla of the brain.

The breathing can be modified, however, by impulses reaching the respiratory center along various nerves.

Impulses originating in the larynx or the bronchi may reach the respiratory center of the medulla, along the Vagus or inhibitory nerves (these nerves also send fibers to the larynx, bronchi and lungs as well as to the heart). These impulses may cause the respiratory center to send impulses to increase the depth and frequency of breathing (reflex action). Impulses such as those produced by the application of cold air, cold water, etc., to the skin also reach the respiratory center and increase the depth and frequency of breathing.

Dyspnoea

Dyspnoea is deep and labored breathing, which occurs when a patient has difficulty in getting air into the lungs.

The chest is made wider by the forcible contractions of all the muscles attached to the chest from the arms, neck and abdomen. The lungs therefore expand more than usual, which increases the depth of inspiration. The contractions of the diaphragm and intercostal muscles are also increased, which makes the chest smaller with each expiration, expelling more air.

Dyspnoea may be caused by obstruction in the air passages. It frequently also occurs when the blood is impure, containing an excess of carbon dioxide. This increases the impulses for breathing sent out from the medulla of the brain, thereby making the breathing deeper and more labored.

Apnoea

When the breathing is so slow and shallow that the movements of the chest can hardly be seen, it is called **apnoea**.

Cyanosis

Cyanosis is a blue color of the skin. It is caused by the dark color of the blood in the superficial blood vessels. This dark color is due to the methaemoglobin which the blood contains, as a result of an excess of carbon dioxide. It usually results when the patient does not get enough oxygen into the lungs to purify the blood.

Coughing

Coughing is a violent expiration preceded by a deep inspiration. When a patient coughs, there is a deep inspiration at first, followed by violent contractions of the abdominal muscles, which push the abdominal organs up against the diaphragm. The diaphragm then presses up against the lungs, and violently expels the air and secretions which they contain. The expiration is violent, because the larynx is closed at the time when it occurs.

Coughing is a reflex act. It occurs when an object lodges in the larynx, when the bronchi are irritated or inflamed, or when they contain a great deal of mucus. These affect the nerve endings in the bronchi, which send impulses along the Vagus nerves to the respiratory center in the medulla. The center immediately sends back impulses to cause violent respiratory contractions of the diaphragm, and coughing results.

Drugs affect the respiration in two ways:

1. Increasing the breathing: **stimulation**.
2. Lessening the breathing: **depression**.

Respiratory Stimulation

When the respiration is stimulated, the breathing is usually deeper and faster. More air, and, therefore, more oxygen enters the lungs and then the blood.

Respiratory stimulation is produced in several ways:

1. By sending more impulses for breathing from the respiratory center of the medulla of the brain.
2. By irritation of the mucous membrane of the bronchi, impulses are sent along the Vagus nerves to the respiratory center of the medulla. This center at once sends back impulses to make the breathing deeper and faster (reflex action).
3. By improving the condition of the blood, the medulla is supplied with better and purer nourishment. It is therefore better able to send out more impulses for breathing.

Respiratory Depression

The breathing is usually made slower by drugs which lessen the activity of the respiratory center in the brain, or which lessen the irritation in the respiratory organs.

RESPIRATORY STIMULANTS

The following drugs are used as respiratory stimulants:

Atropine
Caffeine
Strychnine
Camphor
Alcohol
Ammonia

They make the breathing deeper and faster. They produce this effect by increasing the impulses for breathing sent out from the respiratory center. Their general action has already been considered, or will be considered later.

Respiratory stimulants are principally used in the treatment of collapse.

Atropine and **Caffeine** are the best respiratory stimulants.

Strychnine is often used to increase coughing.

Ammonia is given by inhalation, usually in fainting.

OXYGEN

Oxygen is a gas which constitutes 20% of ordinary air, and is necessary for the life of all animals. It is inhaled by the lungs with the inspired air.

Action

Local action: Oxygen is a very good antiseptic, since most bacteria are unable to live in an atmosphere of pure oxygen.

Internal action: When pure oxygen gas is inhaled, it enters the plasma of the blood, from the air sacs of the lungs. Some of the oxygen combines with the haemoglobin of the red blood corpuscles, forming oxyhaemoglobin, while part of it circulates uncombined, in the plasma. The formation of a greater amount of haemoglobin gives the blood a brighter color, and the color of the skin then becomes more ruddy.

The improved condition of the blood **makes the breathing slower, and slows and strengthens the heart action.**

The red corpuscles carry the oxygen to the various tissues and organs of the body, where it combines with some of the constituents of their cells, and thus enables the organs to carry on their various activities.

Uses

Oxygen is used in **pneumonia**, when the patient's color is blue or cyanotic, as a result of inability to obtain enough oxygen into the blood from the lungs, because part of the lung is consolidated. The inhalation of oxygen often relieves this blue color, and makes the breathing easier.

Oxygen is also given in **potassium chlorate, and in illuminating gas poisoning**. These drugs combine with the haemoglobin of the blood, and prevent it from taking up oxygen from the lungs. When oxygen is given in such cases, it enters the plasma in sufficient quantity to supply the tissues with nourishment until the haemoglobin is freed from the poisonous substance.

Administration

Oxygen should always be given continuously; inhaled through a mask from a tank along the bedside. The inhalations should be stopped when the cyanosis disappears.

It is also given by means of a specially constructed apparatus, or the patient is placed in a specially constructed tent, in which he continually inhales oxygen.

RESPIRATORY DEPRESSANTS

The following drugs make the breathing slower and shallower. They will be described later, under their more important effects.

Opium

Morphine

Codeine

Bromides

Chloral

Luminal
Veronal
Sulphonal
Paraldehyde
Dilute Hydrocyanic Acid

DILUTE HYDROCYANIC ACID

(Dilute Prussic Acid)

Dilute hydrocyanic acid is a 2% solution of pure hydrocyanic or prussic acid. The concentrated acid is formed by the combination of hydrochloric acid and silver cyanide. It is a colorless, inflammable fluid which evaporates very easily. Hydrocyanic acid is the most poisonous substance known. The inhalation of its fumes causes instant death. Scheele, the chemist who discovered it, is said to have died in this manner.

Bitter almonds, and the kernels of the seeds of various fruits such as peaches, cherries, apricots, plums and prunes, contain a glucoside, **amygdalin**, and a ferment, **emulsin**. When the kernels of these fruits are rubbed in water, the emulsin changes the amygdalin to **prussic acid**, glucose, (a sugar) and another substance. The syrup of wild cherry bark (**syrupus prunus virginiana**) also contains very small quantities of hydrocyanic acid.

1. **Applied locally to the skin or mucous membranes**, it causes numbness by paralyzing the nerve endings of the sensory nerves. It is used for this effect to allay itching and to check nausea and vomiting.

2. **Given internally**, it makes the breathing somewhat slower and shallower by lessening the impulses for breathing that are sent from the respiratory center.

Dilute hydrocyanic acid is rarely used except as an ingredient of cough mixtures to lessen the cough.

Large doses affect the protoplasm of the cells so that it is unable to combine with oxygen and therefore causes severe poisonous symptoms.

Hydrocyanic Acid Poisoning

Hydrocyanic acid poisoning usually results when the acid, or any of its salts, are taken with suicidal intent; or from the inhalation of its fumes in a chemical laboratory.

Symptoms

When a sufficiently large dose is taken, there is a slight convulsion and death results immediately from paralysis of the heart and respiration.

If the dose has not been very large, the following symptoms appear in a few seconds:

1. Nausea and vomiting.
2. The patient falls to the ground unconscious.
3. Dilated pupils.
4. Very slow, shallow and irregular breathing. Often the expiration is prolonged, and followed by a long pause, during which the breathing seems to have stopped.
5. Very weak and irregular pulse.

6. Cyanosis, cold moist skin.

7. Odor of acid on the breath.

8. Convulsions, with clinching of the muscles of the fingers and toes.

Death usually results from paralysis of the respiration, within fifteen minutes.

Treatment

Rapid, vigorous treatment is necessary in order to save the patient. Usually, however, the symptoms appear so rapidly, that death results in spite of the most active treatment. If the patient can be kept alive for about twenty minutes to a half hour, the chances of recovery are increased, as most of the drug is then excreted.

1. Wash out the stomach.

2. Give artificial respiration continuously, as long as the patient is alive. This helps to eliminate the drug through the lungs.

3. Apply cold applications to the head and spine to keep up the breathing.

4. Iron hydroxide, peroxide of hydrogen or potassium permanganate are usually given to neutralize the acid.

5. Heart and respiratory stimulants are usually given intravenously, or hypodermically.

Dilute Hydrocyanic Acid	0.12–0.5 c.c.	m. ii–viii
(Acidum Hydrocyanicum Dilutum)		

This contains 2% of hydrocyanic acid. It should always be fresh, as it decomposes very easily.

EXPECTORANTS

Expectorants are drugs which tend to fluidify and increase secretions of the mucous membrane of the bronchial tubes. They are frequently divided into two groups: **stimulating and sedative expectorants**. The stimulating expectorants are used to increase the expectoration and to lessen the cough. The sedative expectorants are used to relieve spasms of the bronchial muscles and to relieve spasmodic cough.

The stimulating expectorants most commonly used are the following:

Ipecac

Ammonium Chloride

Solution of Ammonium and Anise

Brown Mixture

Stokes' Expectorant

The sedative expectorants most commonly used are the following:

Wild Cherry

Horehound

Terpin Hydrate

Morphine
Codeine
Heroin

and other preparations of opium.

STIMULATING EXPECTORANTS

IPECAC

Ipecac is a drug obtained from the roots of the *Cephaelis Ipecacuanaha*, a plant growing in Brazil, Colombia and other parts of South America. Its active principles are the alkaloids: **Emetine, Cephaeline, and Psychotrine.**

Appearance of the Patient

If a patient is given a small dose of ipecac there is produced an increased secretion of mucus from the nose and from the bronchi with increased coughing of mucoid expectoration. If a moderately large dose is given the patient feels nauseous and vomits profusely.

Action

1. **Applied locally on the skin**, ipecac is irritating, producing itching and small pustules.
2. **When given by mouth** it acts principally on the mucous membranes. If the dose is small it is absorbed and increases the secretion of all the mucous membranes. The effect on the mucous membrane of the bronchi produces increased mucoid expectoration and cough. In the nose, it increases the flow of mucus and in the eyes the flow of tears.
3. It increases the flow of saliva and sweat.
4. When given in sufficiently large doses it produces nausea and vomiting, in addition to increased secretion of the mucous membranes.

Specific Action

Ipecac is also used as a specific for amoebic dysentery and in pyorrhoea alveolaris. The effect is due to the emetine, which destroys the amoeba, a single celled organism which is the cause of the former, and is found in the secretions of the latter disease.

Uses

In small doses, ipecac is used principally as an expectorant and in large doses as an emetic, to produce vomiting.

Administration

If given to produce vomiting, it is best to dilute ipecac preparations in warm water. If given as an expectorant, especially to children suffering with croup, the preparations should be given in syrup. For its specific action ipecac should be given in keratin coated pills to avoid its action on the stomach, and thereby to prevent vomiting.

Preparations

Solid Preparations

Powdered Ipecac	as emetic 2.0 Gms.	grs. xxx
(Pulvis Ipecacuanhae)	as expectorant 0.06–0.3 Gms.	grs. i–v
Powdered Ipecac and Opium (Dover's powder)	0.3 –1.0 Gm.	grs. v–xv
(Pulvis Ipecacuanhae et Opii)		

This contains 10% opium and 10% ipecac

Fluid Preparations

Fluidextract of Ipecac	as emetic 1.0–2.0 c.c.	m. xv–xxx
(Fluidextractum Ipecacuanhae)	as expectorant 0.2–0.5 c.c.	m. iii–viii
Syrup of Ipecac	for infant, as emetic 2.0–4.0 c.c.	℥ ½–i
(Syrupus Ipecacuanhae)	as expectorant 0.1–1.0 c.c.	m. ii–xv

This preparation is given to children. It contains 7% of the fluidextract.

Active Principles

Emetine Hydrochloride	0.02–0.06 Gm.	gr. $\frac{1}{3}$ –i
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This is used with good results in the treatment of amoebic dysentery. It is given hypodermically in small doses and by mouth in the maximum dose.

APOMORPHINE

This is given in small doses as a stimulating expectorant. (For other effects see page 161.)

AMMONIUM CHLORIDE

Ammonium chloride is an alkaline salt formed by the combination of ammonia and hydrochloric acid. It produces the following effects:

1. It has a nauseating taste.
2. When given by mouth it is quickly absorbed and is eliminated by the mucous membranes, increasing their secretions.

It is principally used to increase the secretion of the bronchial tubes and to increase the cough and to fluidify the mucus, as a stimulating expectorant.

It is best given in a mixture with other expectorants.

Preparations

Ammonium Chloride	0.3–1.0 Gm.	grs. v–xv
(Amonii Chloridum)		

Troches of Ammonium Chloride
(*Trochisci Ammonii Chloridi*)

Each contains about 0.12 Gm. (grs. ii) of ammonium chloride, with 0.25 Gm. (grs. iv) of licorice extract, and some syrup of tolu.

Other Ammonium Preparations

Solution of Ammonia and Anise
(*Liquor Ammonii Anisatus*)

This preparation contains: oil of anise, 1 part; ammonia water, 5 parts; alcohol, 24 parts.

It is not official in this country, but it is extensively used, and is a very valuable preparation. It is an excellent stimulating expectorant and is given in doses of 0.6–2.0 c.c. (m. x–xxx).

Ammonium Carbonate	0.3–0.6 Gm.	grs. v–x
(<i>Ammonii Carbonas</i>)		

SENEGA

Senega or snake root is obtained from the root of the *Polygala senega*, or **senega snake root**, a plant growing in the middle and southern United States. It is used principally as a stimulating expectorant and somewhat as a diuretic.

Syrup of Senega	4.0–8.0 c.c.	ʒi–ii
(<i>Syrupus Senegae</i>)		

Expectorant Mixture

Mistura Pectoralis
(*Stokes' Expectorant*)

This contains ammonium carbonate 0.5 Gm. (grs. viii) fluidextract of senega 1.0 c.c. (m. xv), fluidextract of squill 1.0 c.c. (m. xv), paregoric 5.0 c.c. (ʒi½); in each ounce, and syrup of tolu.

SEDATIVE EXPECTORANTS

TERPIN HYDRATE

Terpin hydrate is a colorless crystalline substance made from the oil of turpentine, by the action of nitric acid, alcohol and water. It is used principally as an expectorant, and to check the secretion of the bronchial tubes.

Preparations

Terpin Hydrate	0.06–0.3 Gm.	grs. i–v
(<i>Terpini Hydras</i>)		
Elixir Terpin Hydrate with Heroin	4.0 c.c.	ʒi
(<i>Elixir Terpini Hydras cum Heroin</i>)		

This contains approximately 0.06 Gm. (gr. i) of terpin hydrate and 0.001 Gm. (gr. $\frac{1}{80}$) of heroin in each teaspoonful dose.

TOLU OR BALSAM OF TOLU (BALSAMUM TOLUTANUM)

Tolu or balsam of tolu is a reddish yellow sticky semi-solid substance, which dissolves in alcohol, but not in water.

Its action is due to the benzoic acid which it contains.

It is used principally as an expectorant. It is an ingredient of many cough mixtures.

Syrup of Tolu	10.0-30.0 c.c.	3ii½-5i
(Syrupus Tolu)		

PRUNUS VIRGINIANA (WILD CHERRY)

Prunus Virginiana is obtained from the bark of the wild cherry tree.

Its active principles are **amygdalin**, a glucoside, and a ferment, **emulsin**. When rubbed together these two substances form prussic acid (hydrocyanic acid).

Wild cherry is often given to increase expectoration and lessen coughing, together with other cough medicines.

Syrup of <i>Prunus Virginiana</i>	4.0-15.0 c.c.	3i-iv
(Syrupus Pruni Virginianae)	This is 15% in strength	

GLYCYRRHIZA (LICORICE ROOT)

Licorice forms an ingredient of many cough mixtures. It lessens coughing by protecting the mucous membrane of the throat and larynx and thus avoiding irritation. The following is the most commonly used preparation containing licorice:

Compound Licorice Mixture	2.0-10.0 c.c.	3½-ii½
(Mistura Glycyrrhizae Compositus)		
Brown Mixture		

This is a soothing cough mixture which contains licorice, paregoric, wine of antimony, and spirit of nitrous ether.

Other Sedative Expectorants

Bromoform

This is given in 0.2 c.c. (m iii) doses to lessen spasmodic cough in whooping cough. It is also used as a hypnotic.

PULMONARY ANTISEPTICS

Pulmonary antiseptics are drugs which act as disinfectants or germicides in the lungs. They are used in two ways: by inhalation and by mouth. When they are given by mouth they are excreted through the expired air, acting as antiseptics in the lungs. When inhaled they act locally on the mucous membrane of the bronchi and in the lungs. The pulmonary antiseptics commonly used are the following substances:

Creosote
Guiacol
Benzoin

CREOSOTE

Creosote is a volatile oil prepared by distilling wood-tar. It contains about 70% of guiacol. It produces the following effects:

1. Locally, it relieves pain and acts as an antiseptic.
2. When given by mouth it is irritating to the stomach and may cause nausea and vomiting. It also acts as an intestinal antiseptic.
3. It is absorbed from the intestines and it then increases the perspiration and all the secretions of mucous membranes, especially **the bronchial secretions**. It may lower temperature.
4. It is eliminated by the lungs and urine. It acts as an antiseptic in both of these organs.

Creosote is used principally as an antiseptic in pulmonary tuberculosis, in lung abscesses, and to lessen a chronic cough. It is given in milk, cod liver oil or in gelatin capsules; and often by inhalation.

Preparations

Creosote (Pure Beechwood) (Creosotum)	0.06-0.3 c.c.	m. i-v
Creosote Carbonate (Creosotal)	0.3-2.0 Gms.	grs. v-xxx
Guiacol	0.5 c.c.	m. viii

Guiacol is a colorless volatile liquid made by the distillation of beechwood tar creosote. It acts like creosote. Large doses often turn the urine a dark brown color and cause diarrhoea.

Guiacol Carbonate (Duotal) (Guiacol Carbonas)	0.3-1.3 Gm.	grs. v-xx
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New and Non-Official Preparations

Guiacol Salol (Guiacolis Salicylas)	1.0 Gm.	grs. xv
Guiacol Benzoate (Guiacolis Benzoas)	0.2-0.6 Gm.	grs. iii-x

This is changed in the intestinal tract to guiacol and benzoic acid. It is used as an intestinal antiseptic for diarrhoea, and also for cystitis.

Calcreose (Calcium Creosote)	0.25-1.0 Gm.	grs. iv-xv
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This is a mixture consisting of equal parts of calcium and creosote. It is used like creosote, but it is not so apt to cause nausea and vomiting. Since it is slowly absorbed it can be given in larger doses than creosote.

Thiocol (Potassium Guiacol Sulphonate)	0.3-1.3 Gm.	grs. v-xx
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This is used as a sedative expectorant for chronic coughs, tuberculosis and diarrhoea. It is much more pleasant to take than creosote or guaiacol.

BENZOIN

This is the thickened sap obtained from the *Styrax benzoini*, a Peruvian tree. Its compounds are used principally to increase the secretions in the lungs, and in inflammations of the nose, throat and bronchi.

Tincture of Benzoin (<i>Tinctura Benzoini</i>)	2.0-4.0 c.c.	3½-i
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Compound Tincture of Benzoin (<i>Tinctura Benzoini Composita</i>)	2.0-8.0 c.c.	3½-ii
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This contains benzoin, styrax, aloes and balsam of tolu. It was formerly known as *Balsamum traumaticum*. It is contained in a number of old remedies, such as *Friar's balsam*, *Turlington's balsam*, *Jesuit's drops*, etc. It is frequently given by inhalation for inflammations of the larynx and bronchi. Benzoin is also contained in the balsam of Peru and balsam of Tolu.

Other Pulmonary Antiseptics

Apinol (<i>Apinolum</i>)	0.3-1.0 c.c.	m. v-xv
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This is obtained by the distillation of a species of pine wood. It is used as an expectorant, and as a germicide, given by mouth or by inhalation.

Oil of Pine Needles
(*Oleum Pini*)

This is used as an inhalation and disinfectant, in chronic bronchitis and laryngitis.

PART VI.—DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM

A. DRUGS WHICH STIMULATE THE CENTRAL NERVOUS SYSTEM

CHAPTER XIX

PHYSIOLOGY OF THE NERVOUS SYSTEM

The nervous system, or cerebro-spinal system, consists of a number of organs which regulate the activities of all the other organs and tissues of the body.

It increases or diminishes the activities of the various organs of the body. It harmonizes the functions of one organ with those of another, and the activity of the body with its surroundings.

The nervous system consists of the brain, the spinal cord, the nerves, and nerve endings.

The Brain

The brain is an organ situated in the skull. It consists of an outer part which has numerous folds, called convolutions. This outer part is gray in color and consists of numerous microscopic cells. The inner part of the brain is white in color, and consists of numerous microscopic fibers coming from, or going to, the cells in the gray matter. The cells of the gray matter are the active parts of the brain. The brain is divided into three parts:

1. The Cerebrum
2. The Cerebellum
3. The Medulla Oblongata

The **cerebrum** forms the largest part of the brain and is often called the fore brain.

The **cerebellum** is much smaller than the cerebrum, and is situated immediately behind the cerebrum and is often called the hind brain.

The **medulla oblongata** joins the cerebrum to the spinal cord and is often called the mid brain.

Action of the Cerebrum

The cells of the gray matter of the cerebrum do three kinds of work:

1. Sensory
2. Motor
3. Mental

The **sensory work** of the brain consists of receiving impulses or messages from the various organs of the body.

The **motor work** of the brain consists of sending out impulses or messages to the various organs of the body.

The **mental work** of the brain consists of associating impulses and impressions received, or those sent out by one group of cells of the brain, with the impulses or impressions of another group.

Sensory Function of the Brain

There are five kinds of sensory impressions received by the brain.

1. Sense of Sight
2. Sense of Hearing
3. Sense of Smell
4. Sense of Taste
5. Sense of Touch

Sense of Touch

The brain receives impressions through the sense of touch by means of numerous nerves which reach it either directly or through the spinal cord. The impressions are received by numerous nerve endings scattered over every part of the skin, from which they are carried along the various nerves to the brain or spinal cord.

There are four different kinds of impressions received by the nerve endings in the skin. Many of these sensations are received by special nerve endings, and reach the brain or spinal cord by separate nerve fibers.

1. **Sensation of touch:** This is a sensation whereby the consistency and shape of an object is determined by feeling it; whether it is hard, soft, smooth or rough; whether it is round, square, etc.

2. **Sensation of pain:** This is an unpleasant sensation, whereby the body is able to avoid injurious objects. This sensation makes us aware of various diseased conditions, such as inflammation, injuries, etc.

3. **Sensation of temperature:** This is a sensation whereby the brain is able to determine whether an object is hot or cold, by means of impressions received by the brain from various nerves coming from special nerve endings in the skin.

4. **Muscular sense:** This is an important sensation whereby the brain is constantly informed of the position of the various joints of the body. This enables us to walk about, without continually watching our steps, or to button our clothes without watching this act etc. In some diseases such as locomotor ataxia, where this sense is affected, the patient is unable to walk without the aid of sight.

All the impressions received by the brain through the various senses are stored up in the cerebrum. When a similar impression is received again it is at once recognized. For example, an object or color when seen again is recognized as having been seen before, and under which circumstances it was seen.

Motor Functions of the Brain

The impulses sent out from the brain are principally the following:

1. Impulses for Motion
2. Impulses for Speech

Impulses for Motion

Certain areas of the gray matter of the brain contain cells which constantly send out impulses to make the muscles contract, and thereby produce the various movements of the body. This part of the brain is called the **motor center**. There are two such centers; one on each side of the brain. Each center sends out impulses to cause and to regulate the movements of the opposite side of the body.

Psychical or Mental Functions of the Brain

The following activities of the brain are called mental activities. They are probably not due to the action of any particular area of the brain, but to the function of a number of areas together, or to the action of one part of the brain upon another.

1. **Consciousness**
2. **Attention**
3. **Memory**
4. **Reasoning**
5. **Judgment**
6. **Emotion**
7. **Imagination**
8. **Will power**

Consciousness

By consciousness, we mean that we are aware of objects and persons about us, of the time of the day, of the place where we are, etc.

Consciousness depends upon our sensations; because the sensations inform the brain of our surroundings. When the sensations are increased, consciousness is increased; when they are diminished, consciousness is lessened. For example, morphine, a drug which lessens the appreciation of the sensations, produces unconsciousness, or sleep.

Function of the Cerebellum

The cerebellum controls our equilibrium, that is, it regulates the direction of movements. It enables us to move forward, backward, from side to side and up and down, without staggering.

When the action of the cerebellum is disturbed, the patient usually staggers. If one side is affected, the patient usually staggers to one side.

Function of the Medulla Oblongata

The medulla oblongata joins the brain to the spinal cord. It consists of small areas of gray matter within, and white matter without. The areas of gray matter are called **centers**. Each center controls a certain function of the body, and constantly sends out impulses along certain nerves to cause or regulate specific activities of the body, which it controls.

Most of these activities are vital, because without them life cannot go on. The following are the most important centers in the medulla:

1. **The respiratory center**, which controls breathing
2. **The cardio-accelerator center**, which makes the heart beat faster.
3. **The vagus or cardio-inhibitory center**, which makes the heart beat slower.
4. **The vaso-motor center**, which controls the width of the blood vessels
5. **The vomiting center**, which sends out impulses to cause vomiting.

Function of the Spinal Cord

The spinal cord is a long cord-like structure situated in the spinal canal, running from the skull to the sacrum. It has numerous nerves attached to it, which carry impulses to and from the cord.

The spinal cord consists of gray matter within, which contains all the cells, and white matter without, consisting of the fibers from these cells, as well as fibers coming from the brain.

The function of the spinal cord is to cause an organ of the body to act, as a result of an impulse received from that organ, or from another part of the body by the spinal cord. Such an action, which is the result of an impulse received, is called a **reflex action**. (It is a reflected action, because it reflects the impulse received, by another impulse which is sent out.)

For example, when the bladder is full of urine, impulses are sent from its inner wall to the spinal cord, which immediately sends other impulses back to cause the muscles in the bladder to contract, thus expelling the urine.

When a hot object is applied to the skin of the arm, an impulse is sent to the spinal cord, which immediately sends out another impulse to make the muscles of the arm contract, and the arm is drawn away.

Reflex actions are controlled by the inhibitory or checking action of the brain. For example, when the bladder is full, it is ordinarily prevented from emptying itself for a short time. This is due to the inhibitory action of the brain which holds the reflex action in check.

The Autonomic Nervous System

The autonomic nervous system is a system of nerves which controls the functions of the organs in the thorax and abdomen as well as the caliber of the blood vessels, and the function of numerous other structures. These nerves originate from a chain of small nodules which are situated along and in front of the spinal cord, and are called ganglia. Each of these ganglia contains a group of small nerve cells which act as relays for many of the nerve impulses passing from the medulla, the brain or the spinal cord, but for the most part they act independently of those influences.

The autonomic nervous system consists of two functionally distinct parts, the **sympathetic** system and the **parasympathetic** system. Since the most important member of the parasympathetic group is the vagus nerve, this group is often called the **vagotonic** system. Each organ in the chest and abdomen receives impulses both from the sympathetic and the parasympathetic nerves. The predominance of impulses from the former or the latter group determines the functional capacity of the organ at any particular time. The tone or the state of contraction or dilatation of the blood vessels is also controlled by these nerves.

The impulses from the sympathetic nerves are antagonistic to those from the parasympathetic. In the abdomen the principal sympathetic nerve carries impulses for checking function, while in organs of the chest these impulses are reversed. The functions of the autonomic nerves may be grouped as follows:

The Vagotonic or Parasympathetic

1. Contracts the pupil.
2. Slows the heart action by impulses along the vagus nerves.
3. In the gastro intestinal tract, increases contractions.
4. Increases uterine contractions.
5. Increases secretions of secretory glands.

The Sympathetic

1. Dilates the pupil.
2. Sends impulses to increase the heart action along the accelerator nerves.
3. Controls caliber of small blood vessels.
4. Sends impulses to the lungs.
5. In the gastro intestinal tract, lessens contractions.
6. Lessens uterine contractions.
7. Lessens secretions of secretory glands.

It is essential to understand the function of the autonomic nervous system since many remedies produce their effects by action on this system.

The Nerves

The nerves are bands of white fibers, which go to, and come from, the brain and spinal cord.

The nerves that carry impulses to the brain and spinal cord are called **sensory** or **afferent nerves**. Those that carry impulses from the brain and spinal cord are called **efferent nerves**. The efferent nerves carry impulses to make the muscles contract, and to increase the secretion of the secretory glands.

The nerves terminate in the skin, the muscles, or the various organs of the body, by means of small microscopic bodies called **nerve endings**.

Conscious, Subconscious and Reflex Action

The activities of the nervous system are of three kinds:

1. **Conscious**
2. **Subconscious**
3. **Reflex**

Conscious actions are activities of the brain, of which we are aware; they occur only in the brain.

Subconscious actions are activities taking place in the brain while we are conscious of something else. We usually, however, later become conscious of subconscious activities.

For example, while we are conversing about a certain topic, we wish to recall the name of a particular individual. We are unable to do so, however, after several attempts, and we then give it up. Some time later, while we are occupied with another topic, the name we had been trying to recall is suddenly remembered.

A process has been going on in the brain, without our being aware of it, which has brought back the memory of the name.

Reflex action is an activity which is the result of a stimulus received by the sensory nerves from the skin or other parts of the body.

Reflex actions may occur in the brain and in the spinal cord. The impulses originating in the gray matter of the spinal cord are all principally reflex in character.

Mode of Action of the Nervous System

The action of the nervous system can be easily understood, if we compare it to a telephone system.

A telephone system consists of a central station, which receives messages from wires, leading to, and coming from, the central station. Messages are sent to the central station, by means of the transmitter, and they are received through the receiver.

The central station keeps all the subscribers in touch with one another. Some subscribers do not communicate directly with the central station, but by means of a sub-station, or a private switchboard. This sub-station must first be communicated with before reaching the central station or any of the subscribers connected to it.

The nervous system acts in a similar manner (see diagram, page 258).

The brain is the central station, which keeps the various organs of the body in communication with one another.

Some organs, such as the eye, the ear and the nose, communicate directly with the brain, through their nerves. In fact, all the cranial nerves communicate directly with the brain. These nerves correspond to the wires leading directly to or from the central station of the telephone system.

The **sensory nerve endings** correspond to the **transmitters** which send impulses along the sensory nerves to the central station, **the brain**.

The **motor or secretory nerve endings** correspond to the **receivers** which receive impulses from the brain, the central station.

The **spinal cord** corresponds to the **sub-station or switchboard**.

Some parts of the body do not communicate directly with the brain, the central station, but through the spinal cord, which corresponds to the sub-station or switchboard. All the impulses from the skin of the trunk and extremities reach the brain in this way. All the impulses for motion reach the muscles of the extremities and trunk indirectly, through the spinal cord.

Just as an institution, having a private switchboard, can connect any of

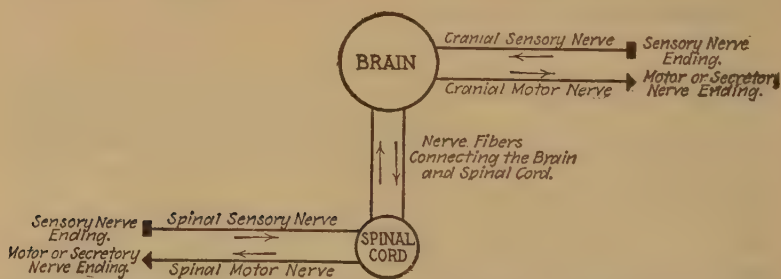


Diagram illustrating the action of the nervous system. The arrows indicate the direction in which the impulses travel

its individuals in one part of the building with other individuals in a different part of the building, so an impulse going to the spinal cord may cause another impulse to be sent out from the spinal cord, without such an impulse being sent to, or coming from, the brain. Such an action is a reflex action.

Mode of Action

For example: When an automobile is seen coming along the street at great speed, we at once get out of its way. The impulse received by the eye when the automobile is seen, is sent to the brain.

The brain then sends out impulses to the spinal cord, which in turn sends impulses to the muscles of the lower extremities causing them to contract. The legs are then moved and we get out of the way of the automobile.

The eyes are thus kept in communication with the muscles of the lower extremities.

Considering the nervous system as a telephone system, the message (the sight of the automobile) is sent to the central station, the brain. This immediately sends a message to the sub-station, the spinal cord, which in turn sends a message to the lower limbs, causing them to move.

Effects of Drugs on the Nervous System

Drugs affect the nervous system in two ways:

1. Increasing its activity, **stimulation**.
2. Lessening its activity, **depression**.

CEREBRAL STIMULATION

Drugs may increase the activity of the entire brain, or only of certain areas of it. In the latter case, only some of the activities of the brain are increased, while others may be normal or even diminished.

Stimulation of the Sensory Activities of the Brain

When the action of the areas of the brain which receive sensory impulses, is increased, the brain receives more impulses through the various senses. The patient is therefore brighter, wider awake, and appreciates his surroundings better; that is, he is more conscious, because consciousness is the result of the sensations received through the various senses.

The patient appreciates all the various sensations better; such as the sense of pain, touch, heat, cold, etc.

Illusions and Hallucinations

When the various sensory areas of the brain are made very active, certain impressions which had been received through the various senses and stored up are revived. The patient then has sensations which do not exist. For example, stimulation of the area for receiving impulses of sight, makes the patient see objects that do not exist. Such impressions are called **hallucinations** or **illusions**. In this example they are **illusions** or **hallucinations of sight**.

If the area for the reception of sound is thus overstimulated, the patient may hear sounds, noises or voices, that do not exist. These are called **hallucinations of sound**.

If the area for the appreciation of the sense of touch is over-stimulated, the patient may feel things that do not exist, such as objects or animals creeping over the skin. These are called **hallucinations of touch**. This often occurs in alcoholic delirium, or delirium tremens.

If the area of the brain which receives sensations of taste or smell is thus affected, the patient may taste or smell objects that do not exist. These are called **hallucinations** or **illusions of taste or smell**.

Stimulation of the Motor Areas of the Brain

When the areas of the brain which send out impulses for motion are stimulated, the patient moves about more, and is more active, because of the greater number of impulses for motion which are sent out from the brain.

Convulsions

When the motor areas of the brain are over-stimulated, however, the impulses for motion are so active, and so many, that instead of regular co-ordinated movements of the muscles, violent contractions, or convulsions result.

Convulsions are of two kinds: **Clonic** and **Tonic**.

Clonic convulsions are repeated single contractions of the muscles of the body.

Tonic convulsions are prolonged contractions of the muscles of the body. During a tonic convulsion the muscles are very rigid.

Stimulation of the Speech Center of the Brain

When the activity of the speech center of the brain is increased, the patient becomes more talkative.

Delirium

When the activity of the speech center of the brain is increased, for example, by some drugs, or by the poisons of infectious diseases, all the impressions and memories for speech that have been stored up in the brain are sent out.

The patient talks continuously: of numerous objects that he has seen in the past, or that he seems to see at present. He may speak various words of different languages that he has heard at some time in his life, etc. This condition is called **delirium**.

The same causes which increase the activity of the speech center also increase the activity of the motor areas of the brain. Delirium is often accompanied, then, by excessive movements of the muscles or by convulsions.

Stimulation of the Mental Functions of the Brain

Drugs which increase the activity of the brain also increase the mental activities of the brain. When these activities are increased, the patient is able to concentrate better and pay closer attention. The reasoning and judgment are also increased and the memory is better.

When the imagination is increased, the patient is better able to combine old impressions into new ones. This may produce visions of various objects, places and people. They may imagine new kinds of sounds, etc.

The imagination may be increased, while the activity of the sensory areas of the brain is lessened. The patient is then unconscious (asleep) but the increased activity of the imagination results in various dreams. Such effects are produced by morphine.

When the inhibitory action of the brain is increased, the patient is able to control the various activities of the brain and other organs better.

Stimulation of the Medulla Oblongata

When the activity of the medulla of the brain is increased, the various centers which it contains becomes more active.

If the **respiratory center** is stimulated, the breathing is deeper and faster.

If the **cardio-accelerator center** is made more active, the heart beats faster and stronger.

If the **vagus** or **cardio-inhibitory center** is increased in activity, the heart beats slower.

If the **vaso-motor center** is more active, the blood vessels become narrower, the pulse is tense, and the blood pressure is increased.

If the **vomiting center** is made more active, the patient usually vomits frequently and profusely.

The entire medulla is rarely stimulated. Most drugs affect only certain centers in the medulla.

Stimulation of the Spinal Cord

When the spinal cord is made more active, the patient is able to respond more rapidly and with greater force to all stimuli and impressions received by the senses.

For example, when the spinal cord is stimulated, the application of a hot object to the hand will cause the arm to be forcibly drawn away, and may even cause convulsions, if the stimulation is very great.

Drugs which increase the activity of the spinal cord, such as strychnine, act as a tonic. This is due to the improvement in the activities of various organs of the body because of the increased reflex action. Such actions as movements of the bowels, which are reflex actions, or which are increased by reflex action, as breathing, are improved.

Stimulation of Autonomic Nerve Endings

There are many drugs which produce their effects by acting on the autonomic nervous system. They usually affect the terminals of the autonomic nerves. The functions of many thoracic and abdominal organs can therefore be modified in this way. For example, stimulation of the endings of the vagus nerve will produce slower heart contractions, while stimulation of the sympathetic nerve endings in the heart will produce accelerated or rapid heart action. Stimulation of the vagus branches to the stomach will produce increased secretion of gastric juice, while stimulation of the sympathetic branches in the abdomen will check peristalsis and secretion.

Stimulation of the Nerves and Nerve Endings

If the sensory nerves or nerve endings are made more active, the patient becomes more sensitive to pain, to heat and to cold. There may even be tingling in the areas of skin affected, a feeling as if there was some object creeping on the skin (formication).

If the efferent or motor nerves are thus affected, the patient may have twitchings of the muscles, if they are motor nerves or nerve endings. If the secretory nerves or nerve endings are thus affected, the glands supplied by those nerves secrete more profusely.

Effects of Excessive Stimulation

When drugs increase the activity of the brain too much (over-stimulation), which often results from excessive doses of drugs which act as cerebral stimulants, the effects are those of lessened activity or depression.

The patient becomes less conscious, falls asleep, and finally goes into a stupor (a deep sleep from which he can be awakened with difficulty). Later, coma develops (a deep sleep from which the patient cannot be aroused at all).

DEPRESSION OF THE NERVOUS SYSTEM

Drugs may lessen the activity of the entire brain or only of certain areas of it. In the latter case, only some of the activities of the brain are lessened, while others may be normal or even increased.

Depression of Sensation

When the activity of the sensory areas of the brain are lessened, fewer sensory impulses reach the brain. The sense of pain, touch, heat, cold, sight

and hearing and all other sensations are lessened. Some drugs, for example morphine, relieve pain in this way.

Since consciousness depends upon the sensory impulses received by the brain, when the reception of these impulses is lessened, the patient is less conscious, or may even be unconscious or asleep.

In overactivity of a cerebral depressant, stupor and coma result.

Motor Depression

When the action of the motor areas of the brain is lessened, fewer impulses for motion are sent out from the brain. The patient is then less active, he usually walks about more slowly and when the effect is marked he may even prefer to remain in one place without any desire to change his position.

Depression of the Speech Center

When the activity of the speech center is lessened, the patient is less talkative; and when he does speak, he is apt to speak slowly and in a low voice.

Depression of the Mental Functions of the Brain

Drugs which lessen the mental activities of the brain make the patient dull and stupid. He is unable to fix his attention or concentrate his mind on any subject for any length of time. The reasoning is very slow and poor, the memory is very poor and the patient is forgetful, dull and unemotional.

When the inhibitory action or will power is lessened, the patient is unable to control the various activities of the brain and other parts of the body.

For example, the action of alcohol begins by lessening the will power. It therefore removes the inhibition from the speech center. It makes the patient talkative, and the individual often says things that may be foolish or improper.

Depression of the Medulla

Drugs which lessen the activity of the medulla usually lessen the action of its various centers.

When the action of the **respiratory center** is lessened, the breathing is slower and shallower.

When the activity of the **cardio-accelerator center** is lessened, fewer impulses which make the heart beat faster are checked, so that the heart then beats slower and weaker.

When the action of the **vagus** or **cardio-inhibitory center** is lessened, fewer impulses for slowing the heart reach it, which makes the heart beat faster.

When the activity of the **vaso-motor center** is lessened, the blood vessels become widened and the skin becomes flushed. The pulse is therefore softer and more bounding in quality.

Depression of the Spinal Cord

When the activity of the spinal cord is lessened, the patient usually responds to stimuli less readily. In other words, the reflex action is lessened. The activity of various organs of the body such as the movements of the bowels, breathing, etc., which are helped by reflex action or which act in a reflex manner, are diminished.

Depression of the Autonomic Nerves

A number of drugs produce profound effects by depressing the autonomic nerves. For example, if the impulses passing along the **vagotonic** nerves are diminished, rapid heart action results. If the impulses along the **accelerator** nerves are diminished, slow heart action results. If the impulses passing along the vagotonic nerve to the stomach are diminished, lessened peristalsis and secretion results. If the impulses along the sympathetic nerves to the gastrointestinal tract are diminished, then excessive peristalsis and secretion of gastric juice is produced.

Depression of the Nerves and Nerve Endings

When the activity of the **sensory nerves** or their nerve endings is lessened, the patient does not appreciate sensations such as touch, temperature, pain, etc. Numbness and tingling in the areas supplied by these nerves are often produced.

When the activity of the **efferent nerves** is lessened the following results are produced:

Lessened contractions of the muscles if they are **motor nerves**. If the depression is very great, as in overactivity of the drug, paralysis results.

Lessening the activity of the **secretory nerves** or their nerve endings results in diminished secretion of these glands.

CHAPTER XX

BRAIN AND SPINAL CORD STIMULANTS

The drugs used principally as stimulants on the nervous system are **caffeine** and **strychnine**.

CAFFEINE (CAFFEINA)

Caffeine is a white crystalline powder, the active alkaloid of the coffee bean, **Coffea arabica**. It is also found in tea leaves, **thea chinensis** of China; in **Paraguay tea** of Argentina and in the **kola nut** of Central Africa and the **guarana paste** of Brazil.

Coffee and tea are commonly used beverages. They are infusions of the coffee bean or of tea leaves. The coffee bean contains about $\frac{2}{3}\%$ of caffeine. A cup of coffee contains about 0.1–0.2 Gm. (grs. $i\frac{1}{2}$ –iii) of caffeine.

Tea contains about $1\frac{1}{2}$ to 2% of caffeine. A cup of tea also contains 0.1–0.2 Gm. (grs. $i\frac{1}{2}$ –iii) of caffeine. Tea contains a large amount of tannic acid, which contracts mucous membranes (astringent action).

Coffee produces the same effects as caffeine, for the action of coffee is due principally to the caffeine which it contains.

Appearance of the Patient

When a patient is given an average dose of caffeine, or when a strong cup of coffee is taken, the following effects are noticed:

The patient is wide awake, brighter, and is able to think more quickly and better, and to reason better. In fact, all mental work can be done better and with less fatigue. The patient is more active and responds more easily, more rapidly and better, to all influences about him. The pulse is quicker and may be stronger, and the breathing is deeper and more frequent. The patient also urinates more frequently and the quantity of urine is increased.

Caffeine is an ideal stimulant, because it increases the activity of almost every organ of the body.

ACTION

Caffeine produces no effects when applied locally on either the skin or mucous membranes.

Internal Action

In the mouth: It has a slightly bitter taste.

In the stomach and intestines: Caffeine produces no effects. Coffee, however, because of a number of volatile oils which it contains, increases the peristalsis, causing mild movements of the bowels.

Action after Absorption

Caffeine is absorbed into the blood in about a half to one hour. It then affects principally the brain, the circulation, the respiration and the kidneys. The effects last only for one or two hours.

Action on the Brain: Caffeine stimulates every part of the brain. As a result the patient is wide awake, more alert and the sensations are keener. His mental activities such as reasoning and memory are increased and he can express himself more clearly.

Action on the circulation: Caffeine acts as a heart stimulant causing rapid and strong heart action, but the effect is not a very lasting one. The pulse becomes somewhat more rapid and perhaps stronger for a short time and there is a slight evanescent rise in blood pressure. This effect is the result of its action on the brain, the spinal cord, the blood vessels and partly, but to a slight extent, to direct stimulation of the heart.

The small blood vessels are made narrow by contraction of the muscle fibres in their walls, as the result of the impulses sent to them from the area of gray matter in the medulla which controls the caliber of these vessels.

Action on the respiration: Caffeine stimulates the respiration; increasing the frequency and depth of breathing.

Action on the kidneys: Caffeine increases the flow of urine by directly stimulating the cells of the kidney. It is one of the best diuretics.

Excretion

Caffeine is excreted mainly by the kidneys in a few hours. Very little caffeine is excreted as such. Most of it is changed to urea, a normal constituent of urine.

Poisonous Effects

Acute caffeine poisoning is very rare, because caffeine is excreted very rapidly. An overdose of caffeine produces the following symptoms:

1. Headache and sleeplessness
2. Restlessness and nervousness and excitability
3. Confusion and delirium
4. Rapid heart action
5. Twitchings of the muscles
6. Profuse flow of urine
7. With larger doses, collapse

Chronic Caffeine Poisoning—"Coffee Habit"

This occurs particularly in people who drink strong coffee habitually. The patient becomes very nervous, is easily excited and disturbed even by the slightest noise. He is unable to sleep, complains of headache, palpitation of the heart and twitching of the fingers and hands. The pulse may be rapid and irregular.

When the patient stops drinking coffee, all these symptoms disappear.

Uses

Caffeine is one of the best stimulants for collapse. In heart weakness, in the course of infectious diseases, caffeine is a valuable drug, because of the general stimulation of the patient and the contraction of the blood vessels which are usually dilated in infections. It is also used as diuretic.

Administration

Caffeine is given in capsules, tablets or powders. It should be given well diluted in water. Since its effects appear rapidly and soon pass off, it is better to give small doses, frequently repeated, than a single large dose. When the effect of one dose wears off, there is more caffeine in the body to produce its effects.

Preparations

Caffeine (Caffeina)	0.06–0.3 Gm.	grs. i–v
(Caffeine Citrate) (Caffeina Citrata)	0.06–0.5 Gm.	grs. i–viii
Effervescent Caffeine Citrate (Caffeina Citrata Effervescens)	4.0 Gms.	℥ i

This is a mixture of caffeine citrate, sodium bicarbonate, tartaric acid and sugar, containing 4% of caffeine citrate. It effervesces when dissolved in water.

Caffeine Sodium Benzoate (Caffeina Sodii Benzoas)	0.06–0.3 Gm.	grs. i–v
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This is an excellent preparation for hypodermic use.

It is usually kept in 25% stock solutions, or in ampoules.

Guarana

This is a paste made from the seeds of *Paullinia sorbilis*, a Brazilian plant. It contains **caffeine and tannic acid**. It is used for sick headache and neuralgia. In Brazil, it is also used to check diarrhoea because of the tannic acid which it contains.

Fluidextract of Guarana	2.0 c. c.	m. xxx
(Fluidextractum Guaranae)		

Kola

There are a number of preparations of the kola nut on the market. Many of them are used as stimulating drinks, because of the caffeine which they contain.

NUX VOMICA AND STRYCHNINE

Nux vomica is obtained from the seeds of the *Strychnos nux vomica*, and *Strychnos ignatia*, trees which grow in the East Indies. The seeds are round, flat discs about the size of a five cent piece, and are often called **poison nut**, or **quaker button**, because they resemble gray buttons.

The active principles are two alkaloids: **strychnine** and **brucine**. The effects of both are the same; but brucine is half as strong as strychnine.

The action of nux vomica is due to the strychnine which it contains.

Appearance of the Patient

When strychnine or a preparation of nux vomica is given, the patient complains of its very bitter taste. After continued administration for some time the appetite is increased and digestion is improved. The patient feels stronger, he does not tire easily, he is more alert and energetic. He responds more quickly and more vigorously to all impressions received through the various senses.

When very large doses are given, the pulse becomes slower and stronger, and the breathing deeper and more rapid.

ACTION

Local action: No effects are produced when either nux vomica or strychnine are applied to the skin or mucous membranes.

Internal Action

In the mouth: Strychnine has a very bitter taste. It is one of the bitterest substances known; a 1-1,000,000 solution gives a bitter taste. Because of the bitter taste, it increases the appetite and the flow of saliva.

In the stomach: Strychnine increases the secretion of gastric juice, and the peristalsis of the muscle wall of the stomach. It therefore aids digestion, and accelerates the passage of food into the intestines.

In the intestines: It may stimulate peristalsis, increasing the bowel movements.

Action after Absorption

Strychnine is absorbed into the blood mainly from the intestines, in about one or two hours. After absorption, it affects principally the circulation, the respiration, and the spinal cord.

Action on the circulation: In the average doses usually given there is no appreciable effect on the heart or circulation. In very large doses it makes the heart beat slower and stronger, causing a slow, strong pulse, and slightly raising the blood pressure.

Mechanism: The strychnine effect of large doses is due to its effect on the vasomotor center of the brain, which is an area of gray matter sending out impulses to control the width of the blood vessels. More impulses are therefore sent out to contract the blood vessels, which become narrower, and offer a greater resistance to the contractions of the heart, which beats stronger. The blood pressure is also increased by contraction of the small blood vessels.

Action on the respiration: Strychnine makes the breathing deeper and faster because of the increased impulses for breathing sent out by the respiratory center in the medulla.

Action on the nervous system: It increases the appreciation of the various sensations if given in sufficiently large doses. It also increases the tone (a state of mild contraction) of weak or slightly paralyzed muscles.

Action on the spinal cord: The principal effect of strychnine is on the spinal cord. It **increases reflex activity**. The strychnine effects are due principally to its action on the spinal cord and medulla.

After continued use, as the result of the increased reflex activity, strychnine acts as a tonic, improving the function of every part of the body. The patient responds better and more readily to all impressions received by the various senses, he feels more energetic, does not tire so easily, the appetite and digestion are better, and the bowels move more often. In short, he feels generally braced up.

When given in shock or collapse, as a result of its action on the spinal cord all the symptoms are improved.

Mechanism: A reflex action is an effect which results from stimulation of sensory nerve endings anywhere in the body. The effect may be muscular contractions, increased secretions, improved breathing, etc.

Strychnine produces its effect by enabling the terminals of the sensory nerves and spinal cord to transmit their impulses more readily to the cells of the gray matter of the spinal cord. These cells then respond more readily to any impulse which reaches them along the sensory nerves, thus increasing the reflex action. As a result of the increased reflex action, all the activities of the body which are affected by impulses received through various sensory nerves are increased.

Acute Strychnine Poisoning

Acute strychnine poisoning usually results from an overdose of strychnine, or when a preparation of the drug is taken with suicidal intent. The symptoms appear very soon after it is taken, usually in about fifteen minutes.

Symptoms

1 The patient complains first of **stiffness of the muscles** of the neck or face, and of slight stiffness of the jaw; soon there follows **twitching of the face or arms**.

2. **Sudden tetanic convulsions of the whole body then occur.** The arms and legs are rigid and extended. The head is drawn back, and the back is bent so that it forms a curve (opisthotonus). The contractions of the facial muscles draw up the corners of the mouth, causing a peculiar grin and ghastly expression known as the "**risus sardonicus**."

The convulsions are due to the increased reflex action, and are brought on by the slightest stimulus; such as a gust of air, the touch of a blanket, a flash of light; or the slam of a door. After the convulsion, all the muscles are relaxed and there is a feeling of soreness, but the slightest touch, a gust of wind, or loud noise, immediately produces another paroxysm.

3. The convulsions become more frequent and the patient finally dies of asphyxia, in about two or three hours, the mind remaining clear to the end.

4. The contractions of the muscles of the diaphragm, during the convulsions, give the **face and lips a blue color**, from the lack of oxygen in the blood, due to interference with the breathing.

5. **The pulse is slow and stronger**, but during the convulsions it is often rapid and weak.

The symptoms of strychnine poisoning are all due to its effect on the spinal cord. In a normal individual, an external stimulus, such as touching the skin, etc., sends an impulse to the spinal cord which results in the contraction of only one, or of a number of muscles; so as to draw the arm or leg away from the stimulus. In strychnine poisoning, afferent impulses are received so readily by the spinal cord that even the slightest stimulus causes a marked response. So many impulses are suddenly sent out from the cord, that violent contractions of all the muscles of the body, or convulsions result.

Treatment

1. Tannic acid or tea are given to combine with the strychnine.
2. The stomach should be washed out or emetics given if strychnine has been taken by the mouth (but not during the convulsions).
3. If the patient has convulsions, ether or chloroform is given to control them, and then the stomach should be washed out.
4. To prevent the convulsions from returning, chloral or bromides are given repeatedly.
5. The patient should be catheterized to prevent reabsorption of the strychnine from the urine.
6. Give artificial respiration and oxygen when the patient is blue and cyanotic.

Cumulative Strychnine Poisoning

Since strychnine is rapidly absorbed and very slowly excreted, some of it always remains in the body when it is given continuously, and often causes cumulative symptoms. These symptoms, which result from the accumulation of strychnine in the body, are the same as the acute symptoms, but they develop more slowly.

Symptoms

1. The earliest symptoms which indicate that the patient is getting too much strychnine, are **twitching of the muscles of the face** or of the **extremities**, such as shrugging of the shoulder or twitching of the fingers.
2. Often the earliest symptom may be **diarrhoea**.
3. Soon the patient complains of stiffness of the neck and jaw or in the muscles of the face.

If the drug is continued, convulsions may occur.

Treatment

Stop the drug as soon as the earliest symptoms are noticed. This enables the strychnine in the body to be eliminated, and further symptoms are avoided. If other symptoms occur, the treatment is the same as for acute poisoning.

Uses

Strychnine is used principally for the following effects:

1. As a heart and respiratory stimulant in collapse.
2. In various forms of paralysis, to increase the contractions of the muscles.

3. As a tonic, to improve the general health and strength of the body.

4. To increase the appetite and to improve the action of the bowels.

Administration

For a rapid effect in collapse, strychnine should be given hypodermically.

To increase the appetite, nux vomica is usually given, before meals, undiluted.

Preparations

Nux Vomica

Solid Preparation:

Extract of Nux Vomica (Extractum Nucis Vomicae)	0.015-0.06 Gm.	gr. $\frac{1}{4}$ -i
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Fluid Preparations:

Fluidextract of Nux Vomica (Fluidextractum Nucis Vomicae)	0.06-0.3 c. c.	m. i-v
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Tincture of Nux Vomica (Tinctura Nucis Vomicae)	0.3-1.0 c. c.	m. v-xv
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This is the preparation most frequently used as a tonic.

Strychnine (Strychnina)	0.0015-0.004 Gm.	gr. $\frac{1}{40}$ - $\frac{1}{15}$
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(Strychnine Sulphate) (Strychninae Sulphas)	0.0015-0.004 Gm.	gr. $\frac{1}{40}$ - $\frac{1}{15}$
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This is the preparation used hypodermically in collapse. In hospital practice it is often used in a 1% or weaker solution.

Strychnine Nitras (Strychninae Nitras)	0.0015-0.004 Gm.	gr. $\frac{1}{40}$ - $\frac{1}{15}$
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Iron and Strychnine Citrate (Ferri et Strychninae Citras)	0.06-0.2 Gm.	gr. i-iii
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Syrup of Iron, Quinine and Strychnine Phosphate (Syrupus Ferri, Quinae et Strychninae Phosphatum)	4.0-8.0 c. c.	ʒi-ii
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This contains $\frac{1}{80}$ of a grain of strychnine in each ʒi dose.

Elixir of Iron, Quinine and Strychnine Phosphate (Elixir Ferri, Quinae et Strychninae Phosphatum)	4.0-8.0 c. c.	ʒi-ii
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This contains $\frac{1}{64}$ of a grain of strychnine in each ʒi dose.

PART VI B.—DRUGS WHICH DEPRESS THE CENTRAL NERVOUS SYSTEM

CHAPTER XXI

BRAIN AND SPINAL CORD DEPRESSANTS

We may classify the drugs which lessen the action (depress) of the brain in the following groups. (See page 261 for cerebral depression.)

1. **Analgesics**
2. **General Cerebral Depressants**
3. **Progressive Cerebral Depressants**
4. **General Anaesthetics**
5. **Hypnotics**

Analgesics are drugs that are used principally to relieve pain. Many of the analgesics depress certain functions of the brain while stimulating others.

General Depressants are drugs that lessen the action of the entire brain.

Progressive Depressants are drugs that progressively depress the functions of the brain. They usually depress the higher functions such as inhibition first, thus removing the restraint of brain activities and causing a stage of excitement. This is followed by progressive depression of all the other functions. In poisonous doses they may produce unconsciousness. Since the excitement is the most apparent symptom, the progressive depressants are often called **intoxicants**.

General Anaesthetics are drugs that produce unconsciousness and insensibility to pain. They usually progressively depress the brain like the Progressive Depressants. The excitement stage, however, is of very short duration and is soon followed by the stage of unconsciousness which may last for a long time and is not accompanied by other poisonous effects.

Hypnotics are drugs that lessen the function of the brain so as to produce sleep, without causing insensibility to pain.

In this chapter we shall consider only the analgesics, general depressants and progressive depressants.

ANALGESICS

Analgesics are drugs used principally to relieve pain.

Pain can be relieved in several ways:

1. By lessening the activity of the sensory areas of the brain so that the impulses of pain which the brain receives are not appreciated.

2. By lessening the activity of the nerve endings in the skin which receive the impulses of pain.

Drugs which relieve pain are divided into two classes:

1. **Analgesics**

2. **Anodynes**

Analgesics are drugs which relieve pain when given internally.

Anodynes are drugs which relieve pain when applied to the particular site where the pain is felt.

The most important analgesic is **opium** and its principal alkaloid, **morphine**. The anodynes will be considered under their appropriate local effects. (See Local Anaesthetics, page 357.)

OPIUM AND MORPHINE

Opium is the hardened dried juice of the unripe capsules of the **Papaver somniferum** or white poppy, a plant which grows principally in Turkey, Asia Minor, Persia, India and China. The drug is obtained by making a longitudinal or transverse cut in the capsule, when a thick white milky juice oozes out. This is exposed to the air, and allowed to dry, when it turns brown and hard. This dried juice is the crude opium, from which all the preparations are made. It has a peculiar characteristic odor.

Opium is one of the oldest drugs in medicine. It is the most reliable and most useful drug in the entire Materia Medica. It relieves pain better than anything else, no matter what the cause of the pain may be.

Active principles: The most important active principles of opium are the alkaloids: **morphine**, **papaverine** and **codeine**.

Opium also contains a number of other unimportant substances. The action of opium is due chiefly to the **morphine** which it contains, amounting usually to 9% of the drug.

Appearance of the Patient

About ten to fifteen minutes after giving an average dose of opium or morphine, the patient complains of less pain. He becomes calm, abstracted and quiet, and feels comfortable. When

spoken to, he may not answer, because of his drowsy, abstracted state.

Soon, however, the patient falls into a light sleep from which he can be easily aroused. Some patients may have pleasant dreams during the sleep. Often the sleep is deeper, resembling the natural sleep.

The breathing is slow and shallow, the pulse is perhaps somewhat slower, the face is flushed, the pupils are contracted and the skin may be moist. These effects last for several hours, and gradually wear off, leaving the patient feeling dull and depressed, with dryness of the throat and occasionally a slight headache and nausea.

ACTION

Local action : Applied to the skin, opium or morphine produces no effect; although a preparation, lead and opium wash, is commonly used for such an effect.

Internal Action

In the stomach: It checks the secretion of gastric juice and lessens the peristalsis. It also lessens the appetite and the feeling of hunger. These effects result from absorption. Later, however, opium or morphine increases the secretions in the stomach, and may even cause nausea and vomiting.

In the intestines: The secretions of the mucous membrane and the peristaltic contractions of its muscle wall are markedly lessened, causing constipation. This effect is also due to absorption.

Action after Absorption

Morphine is very rapidly absorbed into the blood from the stomach, usually in about ten or fifteen minutes. It can also be absorbed from all the mucous membranes.

When given hypodermically, it acts in about two to five minutes. Opium preparations are absorbed more slowly. After absorption, opium and morphine affect principally the brain, the respiration, the secretory glands and the pupil.

Action on the Nervous System

On the brain: Opium or morphine lessens all the activities of the brain, especially the sensations.

On the sensory areas: It lessens appreciation of all sensory impulses, especially that of pain. Since consciousness is the result of the sensory impressions received through the sensations, by lessening the appreciation of sensations, opium or morphine produces sleep. When the patient is unable to sleep on account of

pain, morphine or opium is particularly valuable. The sleep is light, however, and the patient may be easily awakened. It may be deeper and resemble the natural sleep.

The activities of the motor areas of the brain may also be lessened so that the patient is not quite so active and energetic.

Continued use of morphine or opium lessens all the higher mental activities of the brain, such as will power, judgment, reasoning, and concentration. The action of the imaginative center of the brain however, may frequently be increased, and some individuals have vivid dreams. It is because it sometimes produces such a pleasant dreamy state, and helps the individual forget his worries and cares, that opium tends to form a habit, especially after prolonged administration. It undermines the will power however. The opium habitué may even have brilliant ideas while under the effect of the drug, but because the will power is lessened, he is unable to carry them into effect.

Action on the respiration: Opium or morphine makes the breathing slower and shallower by lessening the impulses for breathing, sent out from the respiratory center in the medulla.

Action on the circulation: It produces no effect on the heart. Large doses dilate the blood vessels of the face and neck, however, causing a flushed face and a feeling of warmth.

The pulse after opium or morphine is usually normal and strong. With larger doses, the pulse is somewhat slower.

This is due to the slow breathing which prevents the blood from getting the proper amount of oxygen, and the character of the pulse is due to the slight asphyxia which results.

Action on the secretory glands: Opium or morphine checks all the secretions except the sweat, which it increases.

The flow of saliva, of bile and of the secretions of the mucous membranes of the stomach and intestines are all lessened. The secretion of urine is often markedly diminished.

The perspiration is increased more by the preparations of opium than by those of morphine.

Action on the involuntary muscles: The contractions of the involuntary muscles are lessened. Intestinal peristalsis is thus lessened; which, in addition to the diminished secretion of the intestines, causes constipation.

Action on the pupil: Opium or morphine contracts the pupil. It makes the pupil very small when given internally. When applied locally to the conjunctiva it produces no effects.

Action on metabolism: Morphine lessens oxidation and prevents tissue waste. It occasionally produces sugar in the urine.

Excretion

Opium or morphine is rapidly eliminated from the body, mainly by the digestive tract, into the stomach, intestines and saliva, and slightly by the urine, usually in about an hour. The drug is frequently absorbed again from the stomach and intestines.

Summary of Effects

The most important effects of opium or morphine are the following:

1. It relieves pain.
2. It produces sleep.
3. It makes the breathing slower.
4. It lessens all the secretions except the sweat, which is increased.
5. It checks peristalsis, producing constipation.
6. It contracts the pupil.

Idiosyncrasies

a. Idiosyncrasies of Effect.

In some individuals, the following unusual effects occasionally occur:

1. Weakness and depression.
2. Continual nausea and vomiting.
3. Delirium and excitement. (This is especially apt to occur in women.)
4. Convulsions.
5. Redness of the skin and itching when the effects are passing off.
6. Diminished secretion of urine, especially in case of nephritis.

b. Idiosyncrasies of Dose.

In some individuals a very small dose may cause very deep sleep, and even poisonous effects. In others, a very large dose may cause no effects at all, or only slight effects. Old people and children are very susceptible to opium or morphine. They may get poisonous symptoms from very small quantities.

Poisonous Effects

Poisoning from opium or morphine occurs in two forms: acute opium poisoning and chronic opium poisoning or opium habit.

Acute Opium Poisoning

Acute opium poisoning usually results from an overdose given medicinally, or when a preparation is taken with suicidal intent. Old people or children are very susceptible to morphine.

Symptoms

The symptoms of opium poisoning may begin with vomiting, which may prevent further symptoms. The chief symptoms of opium poisoning are the following:

1. Sleep, stupor, followed by coma.
2. Slow and shallow breathing.
3. Contracted pupils (pin point pupils).
4. Cyanosis.
5. Slow pulse.
6. Profuse perspiration.

Since the most striking effect of opium is sleep, it is customary to divide the symptoms into **three stages**, according to the depth of the sleep:

If the patient can be aroused or is merely inattentive and shows mental sluggishness, this is the first stage.

If he can be aroused with difficulty, brace up and then fall asleep again, this is the second stage, or stage of stupor.

In the third stage the patient is in coma and cannot be aroused at all. The breathing is very shallow, about three or four times a minute and it may be Cheyne Stokes respiration (periods of breathing followed by periods of absent breathing).

The other symptoms are the same in all three stages, except that they are more severe in the third stage.

Treatment

1. The stomach should be washed out with plain water, or better still, with a 1-2000 potassium permanganate solution, which makes the drug inactive. The washing should be repeated every half hour until the patient is entirely out of danger. It should be kept up even if the drug is given hypodermically, as the drug is excreted into the stomach, and repeated washings help to eliminate it.

2. If the stomach cannot be washed out, for lack of apparatus, etc., or if a solid preparation has been taken, emetics should be given repeatedly, about every 15 minutes.

A tablespoonful of mustard in a glass of water, zinc sulphate 0.6-2.0 Gms. (grs. x-xxx), copper sulphate 0.3-0.6 Gm. (grs. v-x) may be given to produce vomiting, and potassium permanganate to destroy the drug.

3. **Atropine**, gr. $\frac{1}{100}$, is given. This is the antidote for morphine. It should be repeated every hour until the breathing becomes deep and rapid again. It should never be given without the

doctor's orders, however, as atropine poisoning may result from its injudicious use.

4. Apply cold douches on the skin, rub or strike the patient with wet towels. This keeps the patient awake and stimulates the breathing. These efforts must not be too violent as they may cause exhaustion.

5. Keep the patient warm.

6. Catheterize.

7. Keep up artificial respiration continuously.

8. Respiratory stimulants, such as caffeine, or a hot coffee enema, strychnine, etc., are given and should be frequently repeated.

9. The application of the faradic current to the Vagus nerve in the neck may help the respiration in some cases.

10. Artificial respiration may be given by means of a pulmotor or by specially constructed apparatus used for giving anaesthesia through the trachea. By the latter method air is pumped into the lungs through a catheter inserted into the larynx.

The treatment of opium poisoning should be kept up for hours, as long as the patient is alive. Patients have recovered from as much as 2.0 Gms. (grs. xxx) of morphine, after persistent treatment.

Chronic Opium Poisoning or Opium Habit

The opium habit occasionally develops in patients to whom it has been necessary to give opium or morphine for a long time. The pleasant effects of the drug and the ease with which it relieves pain and suffering often induce the habit. The drug is usually taken in the form of opium pills or laudanum or by hypodermic injections of morphine. In China and India, the crude opium is smoked by many people. Opium habitués may take as much as 300 grs. of opium without causing dangerous symptoms.

The largest dose which a habitue can absorb is about 4.0 Gms. (3i.) If a larger dose is taken the excess is usually eliminated.

Symptoms

The characteristic symptom is the great craving for the drug. The other symptoms vary according to whether the patient is without his drug or under the influence of his usual dose.

When the habitué is not under the influence of the drug he usually has profuse sweating followed by abdominal cramps, twitching of the muscles and uncontrollable yawning. He is irritable and nervous. He is unable to do his work because he cannot concentrate on anything.

When he gets his usual dose these symptoms disappear; he braces up, becomes energetic and is able to work, and he then feels quite comfortable. Many habitués have no other effects. Usually, however, the devotee passes into a drowsy, dreamy state during which he has so much pleasure that he forgets—his physical pains, his cares, his worries, even his responsibilities. He lives in a world of his own, where all sorts of pleasurable incidents occur. He may get brilliant ideas but is powerless to carry them into effect. Many lie in this state for hours and fall into collapse when they attempt to get up. Finally, the habitué goes into a deep sleep lasting for several hours, and gradually awakes with headache, nausea and weakness.

Prolonged use, however, ultimately undermines both body and mind. The individual becomes thin and anaemic. He has a loss of appetite and various other digestive disturbances. He is usually very constipated although he may have attacks of profuse diarrhoea. He becomes dull and listless, with no self-control, no ambition, and with no sense of truth or honor. Morphine habitués are most inveterate liars and cannot be trusted. Many of them develop all sorts of depraved moral tendencies and some become maniacal or insane.

They usually have a regular pulse, contracted pupils and irregular temperature. The arms may be full of needle marks and occasionally an abscess develops from the use of unsterilized needles.

The habit is treated by gradually withdrawing the drug, the administration of drastic cathartics, and hyoscine as an antidote. Stopping the drug suddenly may cause collapse.

What Can the Nurse Do to Prevent the Habit?

There is no condition more pernicious than the opium habit, because the habitué becomes a useless member of society. The frequency of the habit is indeed surprising. It is claimed that in New York City, in spite of the present stringent legislation, there are about 100,000 habitués. In most instances the habit is not induced by its legitimate medicinal use. Nevertheless the administration of morphine for the relief of pain may be the beginning of a condition that may ultimately lead into a most deplorable abyss.

The nurse should bear these facts in mind, therefore, in administering morphine or opium. Whenever the use of these remedies is indicated, she should use them only after exhausting every art of her profession to relieve the pain or discomfort. If

these measures are of no avail she may give the dose ordered; but the patient should on no account be informed of the nature of the medicine.

In incurable cases accompanied by severe pain and in recurring cancers we must resort to the use of morphine, but this should be done very gradually, lest the time be reached too soon, when even morphine is of no avail.

Uses

Opium or morphine is used for a great many conditions. In fact, there is hardly a condition or disease in which this drug is not useful. It is used principally:

1. To relieve pain. For this purpose it is the best and most reliable drug.

2. To produce sleep, especially when the patient is unable to sleep on account of pain.

3. To lessen peristalsis and produce constipation.

4. To check the secretions, except the sweat.

5. To lessen all forms of nervous excitement, such as delirium tremens, convulsions, tetanus, etc.

Administration

For rapid effects, morphine, given hypodermically, is the best preparation to use. Opium is better where constipation is desired.

Preparations

Opium

Solid Preparations

Powdered Opium	0.03-0.12 Gm.	grs. $\frac{1}{2}$ -ii
(<i>Opii Pulveratum</i>) (Old form <i>Opii Pulvis</i>)		

This contains 12% of morphine.

Deodorized Opium	0.03-0.12 Gm.	grs. $\frac{1}{2}$ -ii
(<i>Opii Deodoratum</i>)		

This contains 12% of morphine, but its odorous substances have been removed.

Pills of Opium	1 pill
(<i>Pilula Opii</i>)	

Each pill contains 0.06 Gm. (gr. i) of powdered opium. These pills must be freshly made, as otherwise they accumulate in the stomach and cause poisonous effects.

Extract of Opium	0.015-0.06 Gm.	gr. $\frac{1}{4}$ -i
(<i>Extractum Opii</i>)		

This contains 20% of morphine.

Powder of Ipecac and Opium	0.6 Gm.	grs. x
(Pulvis Ipecacuanhae et Opii)		
(Dover's powder)		

Each powder contains 0.06 Gm. (gr. i) of ipecac and of opium, and 0.5 Gm. (grs. viii) of milk sugar (it contains 10% of opium). Dover's powder is taken at night in hot lemonade; to break up a cold. It increases the perspiration very freely.

Troches of Licorice and Opium
(Trochisci Glycyrrhizae et Opii)
(Wistar's cough lozenges)

Each lozenge contains gr. $\frac{1}{2}$ of opium. It is used to lessen cough.

Pantopon	0.0075-0.02 Gm.	gr. $\frac{1}{8}$-$\frac{1}{3}$
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This is a mixture of the hydrochloride salts of all the alkaloids of opium.

For Local Use

Opium Plaster
(Emplastrum Opii)

This contains 6% of opium.

Liquid Preparations

Lead and Opium Wash

This is an old preparation containing tincture of opium and lead acetate. It is applied in the form of wet dressings.

Tincture of Opium	0.3-1.0 c.c.	m. v-xv
(Tinctura Opii)		
(Laudanum)		

This contains 10% of opium.

Tincture of Deodorized Opium	0.3-1.0 c.c.	m. v-xv
(Tinctura Opii Deodorata)		
(McMunn's elixir)		

This is now the official **Tincture of Opium** of the U. S. Pharmacopeia. It contains 10% of opium. It contains no narcotine, and no odorous principles, and is therefore more pleasant to take.

Camphorated Tincture of Opium

(Tinctura Opii Camphorata)	For Adults	4.0-16.0 c.c.	℥i-iv
(Paregoric)			

For Children

Under	1 year	0.06-0.3 c.c.	m. i-v
"	2 years	0.3-1.0 c.c.	m. v-xv
"	3 "	0.3-1.3 c.c.	m. v-xx
"	5 "	0.3-1.6 c.c.	m. v-xxv
"	10 "	1.0-2.0 c.c.	m. xv-xxx

Paregoric is a 1 to 250 solution of opium and contains 0.12 Gm. (grs. ii) of opium to 30.0 Gms. or (℥i), together with camphor, benzoic acid, oil of anise and glycerin. It is the best preparation of opium to use for children.

Tincture of Ipecac and Opium	0.3-1.0 c.c.	m. v-xv
(Tinctura Ipecacuanhae et Opii)		
(Tincture of Dover's powder)		

This contains 10% of opium.

Wine of Opium (Vinum Opii)	0.3-1.0 c.c.	m. v-xv
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This is flavored with cinnamon and cloves.

Acetum Opii (Black drop)	0.3-1.0 c.c.	m. v-xv
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This is a mixture of opium extract and dilute acetic acid.

Compound Tincture of Opium (Tinctura Opii Composita) (Squibb's diarrhoea mixture)	4.0 c.c.	3 i
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This contains tincture of opium, tincture of capsicum, spirit of camphor, chloroform and alcohol.

ALKALOIDS OF OPIUM

Morphine

The effects of opium are due principally to the morphine which it contains. They differ slightly from those of opium in the following ways:

1. Morphine is much more rapidly absorbed, and therefore acts more rapidly.
2. It can be given hypodermically.
3. It does not increase the secretion of sweat as much as opium.
4. It is not as constipating as opium.

Preparations

Morphine (Morphina)	0.008-0.03 gm.	gr. $\frac{1}{8}$ - $\frac{1}{2}$
Morphine Sulphate (Morphinae Sulphas)	0.008-0.03 Gm.	gr. $\frac{1}{8}$ - $\frac{1}{2}$
Morphine Hydrochloride (Morphinae Hydrochloridum)	0.008-0.03 Gm.	gr. $\frac{1}{8}$ - $\frac{1}{2}$
Compound Morphine Powder (Pulvis Morphinae Compositus) (Tully's powder)	0.3-1.0 Gm.	grs. v-xv

This contains morphine sulphate, licorice powder, and camphor.

Magendie's solution of morphine.

This is a 1 to 30 solution of morphine sulphate (or grs. xvi to the ounce), which is very commonly used for hypodermic administration. It should always be fresh, as a fungus often grows in old solutions, and makes it unfit for use, or may change the morphine to apomorphine.

U. S. Solution of Morphine	4.0-16.0 c.c.	3i-iv
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This is a 1 to 500 solution of morphine sulphate (or gr. i to the ounce). It is an old unofficial preparation which is still used in some hospitals.

Codeine

Codeine, one of the active alkaloids of opium, is a compound of morphine (methymorphine). Its effects are similar to those of morphine, with the following differences:

1. It does not produce sleep as readily as morphine, and the sleep is very light.
2. It does not make the breathing as slow as morphine does and is therefore safer.
3. It does not produce constipation.
4. It is not so apt to induce a habit.

Preparations

Codeine (Codeina)	0.015–0.06 Gm.	gr. $\frac{1}{4}$ –i
Codeine Sulphate (Codeina Sulphas)	0.015–0.06 Gm.	gr. $\frac{1}{4}$ –i
Codeine Phosphate (Codeina Phosphas)	0.015–0.06 Gm.	gr. $\frac{1}{4}$ –i
Eucodin (Methyl Codeine Bromide)	0.06 Gm.	gr. i

This is used like codeine, to lessen coughing, but it is said to increase the secretion of mucus.

Papaverine is one of the alkaloids of opium which is used principally to relax involuntary muscles. (See page 354.)

Narcotine, one of the alkaloids of opium, causes muscular twitchings, and **thebaine**, another alkaloid, acts like strychnine, causing convulsions. Both of these alkaloids are not used in medicine.

Artificial Alkaloids of Morphine

The following alkaloids are made artificially, by the action of various chemical substances on morphine.

Heroin

This is an artificial alkaloid made from morphine by its combination with an organic salt of acetic acid (diacetyl morphine hydrochloride). Its effects are similar to those of morphine with the following differences:

1. It makes the breathing slower than morphine does.
2. It is used principally to lessen coughing. It does not produce sleep as easily.

The heroin habit has become very common, because of the difficulty in obtaining morphine. It is usually taken by snuffing heroin powder up into the nose. The symptoms are like those of the morphine habit.

Preparations

Heroin (Heroína)	0.0025–0.01 Gm.	gr. $\frac{1}{24}$ – $\frac{1}{6}$
Heroin Hydrochloride (Heroínae Hydrochloridum)	0.0025–0.01 Gm.	gr. $\frac{1}{24}$ – $\frac{1}{6}$

Dionine

This is an artificial alkaloid made from morphine (ethyl morphine). Its effects are similar to those of codeine. It is safer than morphine. It is used to produce sleep and relieve pain. It does not contract the pupil.

Dionine (Dionina)	0.015–0.06 Gm.	gr. $\frac{1}{4}$ –i
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Peronine

This is a substance which has the same effects as dionine. It is given in the same doses.

CANNABIS OR CANNABIS INDICA (INDIAN HEMP)

Cannabis or cannabis indica is a resinous substance obtained from the flowers of the *Cannabis sativa* or Indian hemp, a plant growing in India, Egypt, and the southern part of the United States.

It is used as an intoxicant in various forms in most of the Eastern countries. In India, the dried plant is used for smoking, either alone or with tobacco, and is called *gunjah* or *bhāng*. *Churrhus* or *hashish* is an intoxicating drink containing the resinous juice, which is used in Arabia and Egypt. The resinous substance is often flavored with sugar or honey, and made into a confection. The active principle of cannabis indica is said to be a red oil or resin called *cannabinol*.

Uses

Cannabis indica acts like opium and is used to relieve pain and to produce sleep as a substitute for morphine, in neuralgia, painful menstruation, chorea, hysteria, etc. It is an unreliable drug, however, as many of its preparations are inactive. Preparations made from plants grown in warm climates are usually better.

Effects of Large Doses

When cannabis indica is taken in large doses, or when it is smoked, it usually produces a characteristic state of pleasure and exhilaration which accounts for its frequent use as an intoxicant.

Very soon after taking a large amount of hashish, the individual passes into a drowsy state, during which he has vivid dreams, and forgets everything—cares, worries, troubles, events which occur about him. He has beautiful visions and is usually joyful and happy.

These dreams are more marked in the languid oriental people. Europeans or Americans, unless they are particularly emotional, usually do not have such extravagant dreams, but merely become joyful and happy.

During the state of exhilaration, ideas arise so rapidly that time seems to pass much faster than it actually does. Events which usually last hours seem to occur in several minutes. This state lasts for a short time, perhaps an hour,

and the patient then falls into a normal, quiet sleep from which he can be readily awakened. Sometimes the individual has a sense of impending death. Occasionally the devotee has a dual personality; he feels as if he were two different persons at the same time.

Cannabis indica is given in the form of the extract in doses of 0.015–0.06 Gm. (gr. $\frac{1}{4}$ –i) or in the form of a tincture in doses of 1.0–2.0 c.c. (m. xv–xxx).

LACTUCARIUM

Lactucarium is the dried milky juice obtained from the *Lactuca virosa*, or garden lettuce. It is occasionally used as a substitute for opium, to relieve pain and produce sleep. It is given in the form of a tincture, in doses of 0.6–4.0 Gms. (m. x– $\bar{3}$ i) or as a syrup.

Other Analgesics

The coal tar drugs or the Analgesic Antipyretics are used principally for the relief of nervousness and headache but they also slightly relieve pain. They were originally used to reduce temperature. The following are the coal tar substances most commonly used:

Antipyrine

Acetanilid

Phenacetine

Amidopyrine

Aspirin

GENERAL CEREBRAL DEPRESSANTS

THE BROMIDES

The bromides are crystalline salts formed by the combination of an alkali, such as potassium, sodium, ammonium, etc., with hydrobromic acid. This is an acid formed from bromine, an element found in sea water.

(Every salt consists of two parts: the part derived from the alkali, which is called the base; and the part derived from the acid, which is called the acid radicle. For example, in potassium bromide, the potassium is the base, and is derived from the alkali. The bromide is the acid radicle and is derived from the acid. Every salt when in solution is decomposed into two or more electrical, readily absorbable elements, or ions, as they are called. Each of these ions produces separate and different effects.)

The effects of the bromides are due principally to the acid radicle, or bromide ion. The base of the salt may also produce effects. Each of the bromide salts, therefore, produces a somewhat different effect according to its base.

Potassium bromide is a salt formed by the combination of potassium and hydrobromic acid, or by a chemical reaction of

some of their salts. It is the most active salt of the bromides, and is the preparation commonly used.

Appearance of the Patient

About fifteen or twenty minutes after administering preparations of bromides a nervous or excitable patient gradually becomes calm and quiet. If given to a patient who has tremors or convulsions, these are lessened or prevented from recurring. If it is given around the patient's usual bed time, he may go to sleep. If the bromides are given continuously for some time, the patient becomes less active and the sensations, especially that of pain, become diminished. He manifests little interest in what is going on about him and he becomes forgetful.

ACTION

Internal Action

In the mouth: The bromides have a salty taste and make the throat less sensitive, so that when it is touched, vomiting is not so apt to occur.

In the stomach and intestines: No effect is produced except occasional nausea.

Action after Absorption

The bromides are absorbed through the mucous membrane of the stomach and intestines, usually in a few minutes. They are also readily absorbed from all mucous membranes. After absorption, they affect principally the nervous system.

Action on the nervous system: The bromides lessen the activity of the entire nervous system: the brain, the spinal cord and the nerves.

They lessen twitchings of muscles and muscular contractions.

They slightly relieve pain and produce sleep especially in nervous patients. They make the mental activities rather sluggish.

They lessen nervousness and emotional excitability. They are especially useful to calm and quiet emotional and hysterical patients.

They lessen reflex actions and sexual excitability.

Action on the circulation: In the ordinary doses bromides have no effect, but when the heart is over-active as a result of nervousness, they will lessen the rapidity of the pulse. In large doses, potassium bromide makes the heart beat slower and weaker, due

to the potassium part of the salt. The other bromides do not affect the heart.

Action on the respiration: In ordinary doses the bromides may lessen coughing. Large doses make the breathing slow and shallow.

Excretion

The bromides are very slowly eliminated from the body, mainly in the urine, in the sweat and by all the mucous membranes. It usually takes about 24 to 72 hours for the bromides to be entirely excreted, often even weeks.

Poisonous Effects

Acute poisoning from the bromides does not occur. Since they are rapidly absorbed, but very slowly excreted, when administered continually for a long time the bromides may accumulate in the body, and cause cumulative symptoms, or "bromism."

Symptoms of "Bromism"

The symptoms may appear gradually or suddenly. They are due principally to the exaggerated effects of the bromides, and to the effects on the various tissues and organs through which they are excreted. For example, the rashes which occur are due to the excretion of the drug through the skin.

1. **Skin eruptions.** These consist principally of groups of pimples on the face (acne); or reddish blotches scattered over the skin.

2. Loss of appetite, salty taste in the mouth, bad breath, and disturbed digestion.

3. Constipation.

4. Drowsiness.

5. Stupid, dull expression on the face.

6. Depressed spirits, even melancholia.

7. The eyes look heavy and dull.

8. The patient manifests no interest in his surroundings.

9. Slow, uncertain gait.

10. Slow, stammering speech, often words are forgotten and mispronounced.

11. Very poor memory, even recent events are forgotten.

12. Slow pulse.

13. Lessened reflexes (touching the conjunctiva of the eye does not cause winking, etc.).

Treatment

When the bromides are stopped, the symptoms gradually disappear. Cathartics and hot baths help to eliminate the drug more easily.

Comparative Action of Bromides

Potassium bromide is the most active salt, but in large doses it may weaken the heart action and cause a slow weak pulse.

Ammonium bromide may make the pulse and breathing faster.

Lithium bromide is apt to upset the stomach. It is said to increase the flow of urine.

Sodium and Strontium Bromide produce only the effect of the bromide.

Uses

The bromides are used to lessen overactivity of the brain in the following conditions:

1. To prevent epileptic convulsions.
2. To relieve the muscular twitchings of chorea ("St. Vitus' dance").
3. To relieve emotional conditions, nervousness or excitability, in neurasthenia.
4. To produce sleep when the insomnia is due to nervousness.
5. To lessen sexual excitement.
6. To make a rapid pulse slower, and to lessen nervous heart action.

Preparations

Potassium bromide (Potassii Bromidum)	1.0-4.0 Gms.	grs. xv- $\overline{3i}$
Sodium Bromide (Sodii Bromidum)	1.0-4.0 Gms.	grs. xv- $\overline{3i}$
Ammonium Bromide (Ammonii Bromidum)	1.0-2.0 Gms.	grs. xv-xxx
Lithium Bromide (Lithii Bromidum)	1.0-2.0 Gms.	grs. xv-xxx
Strontium Bromide (Strontii Bromidum)	2.0-4.0 Gms.	grs. xxx- $\overline{3i}$
Calcium Bromide (Calcii Bromidum)	2.0-4.0 Gms.	grs. xxx- $\overline{3i}$
Dilute Hydrobromic Acid (Acidum Hydrobromicum Dilutum)	2.0-12.0 Gms.	grs. xxx- $\overline{3iii}$

This is a 10% solution of hydrobromic acid. About 7.0 c.c. of this solution is equal to 1.0 Gm. of potassium bromide.

Monobromated Camphor 0.3-0.6 Gm. grs. v-x
(*Camphora Monobromata*)

This preparation is used to lessen the nervousness in hysteria, neurasthenia and sexual excitement. Its effect is due mainly to the camphor.

New and Non-official Preparations

Adalin or Carbromal 0.3-0.6 Gm. grs. v-x

This is an organic bromide salt (brom diethyl acetylcarbamide). It produces the same effects as the other bromides.

Brometone 0.3 Gm. grs. v

This is an organic bromide salt (acetone bromoform), which is said not to cause cumulative symptoms.

Bromipin or Bromiol 1.3-10.0 Gms. grs. xx-3iiss

This is a combination of bromine and sesame oil. It usually comes either in a 10 or 33 $\frac{1}{3}$ % solution. It is absorbed slowly, and produces gradual effects. It is claimed that it will not cause cumulative symptoms. It is given in syrup flavored with peppermint water.

Bromo Mangan 4.0-16.0 c.c. 3 i-iv

This is a compound of iron, manganese, bromine and peptones. It contains about 11% of bromine. It is used to soothe nervousness and to build up nervous patients.

Bravalol 0.25-0.75 Gm. grs. iv-xii

This is a compound of a valeric acid salt and bromine. It is used to soothe nervous patients, and is said to be more effectual than either the valerian preparations or the bromides alone.

Sabromin 0.5-4.0 Gms. grs. viii-3i

This is an organic salt formed by the combination of calcium and dibromobenenic acid. It produces the same effects as the other bromides, but they occur more slowly and last longer. It is said to have a more pleasant taste and not to upset the stomach. It usually comes in tablets, each containing 0.5 Gm. (grs. viii).

Triple Bromides

This is a tablet containing 0.4 Gm. (grs. vi) of sodium and potassium bromide with 0.2 Gm. (grs. iii) of ammonium bromide together with sodium bicarbonate and tartaric acid to make it effervesce. It is administered by dissolving in a tumblerful of water.

ANTISPASMODICS (ANTIHYSTERICIS)

Antispasmodics or Antihysterics are drugs which relieve "nervousness." Nervousness is a group of symptoms which

occur in hysteria and neurasthenia. In these conditions patients are more susceptible to all sensory impulses, and they are more emotional. They are usually restless, they lack concentration, and suffer from sleeplessness. They are more irritable and have all sorts of indefinite pains and aches. These symptoms are relieved by many of the drugs in this group in an unknown way; probably by suggestion. Most of the substances have a very strong unpleasant odor, which makes the patients think they are taking a very efficient remedy and the symptoms therefore improve.

Because these drugs often relieve the nervous twitchings of the muscles, as well as the other symptoms of neurasthenia or hysteria, they are often called antispasmodics.

VALERIAN

Valerian is obtained from the roots and underground stems of the *Valeriana officinalis*, a European plant. Its active principle is a volatile oil which has a very unpleasant odor, especially when it is old. It also contains valerianic acid and other substances. It was formerly used in England as a perfume.

When given internally, it produces the following effects:

1. It has an unpleasant taste and odor, it checks the formation and aids in the expulsion of gas from the stomach (carminative action).
2. It allays nervousness, and makes the patient calm and quiet; probably because of its unpleasant taste and odor.
3. It makes the pulse a little faster and stronger.
4. It is said to increase the sweat and the urine.

Preparations

Fluidextract of Valerian (Fluidextractum Valerianae)	2.0-4.0 c.c.	$3\frac{1}{2}$ -i
Tincture of Valerian (Tinctura Valerianae)	4.0-12.0 c.c.	3i-iii
Ammoniated Tincture of Valerian (Tinctura Valerianae Ammoniata)	4.0-12.0 c.c.	3i-iii

New and Non-official Preparations

Valyl (Valeryl-diethylamidum)	0.12 Gm.	grs. ii
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This usually comes in "pearls," two or three of which are given after meals.

Validol (Menthyl Valerianate)	0.6-1.0 c.c.	m. x-xv
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This is a compound of menthol and valerianic acid. It acts like valerian, but is much more pleasant to the taste and has a marked carminative action. It is best given in 10 to 15 drop doses on a lump of sugar.

Validol Camphorate 0.6–1.0 c.c. m. x–xv

This acts like validol, but because of the camphor which it contains, it is believed to strengthen the heart, and it relieves pain when applied locally.

Borneyal 0.25–0.75 c.c m. iv–xii

This is **Borneol isovalerate**, which forms a large part of the oil of valerian, the active principle of valerian.

MUSK (MOSCHUS)

Musk is the dried secretion of the glands situated in front of the prepuce of the **Moschus moschiferus**, or the musk deer of Thibet. It is a dark brown substance, with a very strong characteristic odor.

Owing to the difficulty of obtaining a reliable preparation, musk often produces no effects. If the preparation is a good one, it produces the following effects:

1. It relieves nervousness and calms and quiets the patient.
2. It is said to make the pulse stronger and faster.
3. It often relieves hiccough.

Larger doses have occasionally caused headache, dizziness, confusion, and muscular twitchings, followed by sleep.

Preparations

Musk (powder) (Moschus)	0.5–1.0 Gm.	grs. viii–xv
Tincture of Musk (Tinctura Moschi)	4.0–8.0 c.c	ʒi–ii

HUMULUS LUPULUS (HOPS)

Hops are the dried cones which consist of scales, of the **Humulus lupulus**, or hop vine, a plant growing in England, northern Europe, and the United States. At the base of the scales there is a yellow powder called **lupulin**. The active principle of hops is a volatile oil.

When locally applied, hops relieves pain and causes redness of the skin.

When taken internally, it produces the following effects:

1. It increases the appetite and aids digestion.
2. It is soothing to the brain and lessens nervousness, and may even produce light sleep.
3. It contracts mucous membranes.
4. It is said to increase the perspiration.

Administration

Hops are usually applied in the form of bags containing the crude hops. The bags are soaked in water and wrung out, or they may be heated and used dry. They are then applied locally.

Pillows made from hops are used to induce sleep.

Preparations

Lupulin (powder) (Lupulinum)	0.3-1.2 Gm.	grs. v-xx
Fluidextract of Lupulin (Fluidextractum Lupulini)	2.0-8.0 c.c.	$3\frac{1}{2}$ -ii
Oleoresin of Lupulin (Oleoresina Lupulini)	0.1-0.3 Gm	grs. $i\frac{1}{2}$ -v

PROGRESSIVE CEREBRAL DEPRESSANT

ALCOHOL (ALCOHOL ETHYLICUM)

Alcohol is a colorless fluid which evaporates very quickly. It has a pungent odor, and a burning taste. It burns very easily with a blue flame, and it is often used for heating purposes.

Alcohol is formed by the growth of the yeast plant (a vegetable organism) in a solution of fruits or vegetables containing sugar. This process is called **fermentation**. Starchy fruits or vegetables also produce alcohol on fermentation, because the starch is changed to sugar, which is then fermented by the yeast. The growth of the yeast plant changes the sugar to alcohol and carbon dioxide.

Some alcoholic preparations are made by **distillation**. The fermented fruit, rye or corn is heated in a large vat. Since the alcohol evaporates very easily, it turns to vapor when it is heated. The vapor then passes along a series of tubes into a cool receptacle, where the vaporized alcohol again becomes fluid. Distilled liquors are made in this way.

Appearance of the Patient

After an ordinary dose of any alcoholic liquor, such as whiskey or wine, the pulse becomes rapid and bounding and the breathing is deeper. The face is flushed, the eyes are bright and there is a feeling of warmth. When larger quantities are taken, in addition to these effects the individual usually becomes cheerful, is satisfied with himself, his surroundings, and those about him. He is perhaps more active and more talkative.

ACTION

Local action: Applied to the skin, alcohol causes redness and itching. It hardens the skin, checks perspiration and acts as an antiseptic. Because it evaporates quickly, it makes the skin feel cold. If its evaporation is prevented, however, or if the skin surface is injured, alcohol is irritating.

On mucous membranes: It causes a burning sensation and is astringent.

Internal Action

In the mouth: Alcohol has a burning taste, it increases the flow of saliva and irritates the lining membrane of the mouth. Strong preparations, such as whiskey, often cause a burning sensation in the throat and cause a fit of coughing, and a flow of tears from the eyes and nose.

In the stomach: Small quantities of weak alcoholic drinks, such as beers or wines, aid the appetite and increase the secretion of gastric juice. Larger doses check the secretion of gastric juice and aid the expulsion of gas (carminative action). Strong solutions irritate the stomach and duodenum.

In the intestines: By the time alcoholic drinks reach the intestines they are so weak that they do not cause any effects. In excessive doses they may produce mild bowel movements. Some preparations, such as brandy, check diarrhoea.

Action after Absorption

Alcohol is very rapidly absorbed, usually in about fifteen minutes. Most of it enters the blood through the lining membrane of the stomach, but a small part passes through the mucous membrane of the intestines.

After absorption, alcohol affects principally the circulation, the respiration, and the brain.

Action on the Circulation

The effects of alcohol on the circulation are **reflex** and **direct**. The reflex effects occur from the local action on the mucous membranes and appear before the alcohol is absorbed. The direct effects occur after absorption.

Immediate reflex effects: Almost immediately, but evanescently, after administration of an alcoholic preparation by mouth or hypodermically, the heart beats faster and somewhat stronger, causing a **rapid bounding pulse**. At the same time the skin becomes flushed by dilatation of its blood vessels.

These effects are reflex and are the result of the local irritation in the mouth or at the site of injection, which start impulses to the medulla of the brain. The medulla responds to these impulses by sending other impulses to the heart to make it beat faster and stronger, and to the blood vessels to make them dilate.

Effects after absorption: After absorption alcohol makes the heart beat slightly stronger and faster. It increases the con-

tractions of the heart muscle and lessens the impulses sent from the medulla to slow the heart. In large doses it lessens the contractions of the heart muscle.

In weakened conditions alcohol may act as a food, supplying the heart with energy and thus increasing its muscular contractions.

Action on the respiration: In large doses alcohol makes the breathing deeper and more rapid.

Action on the nervous system: Alcohol progressively lessens the action of the brain. It begins by affecting the highest intellectual activities, such as will power, judgment and reasoning. It then affects the motor and sensory functions. Finally it lessens the action of the entire brain and of the medulla as well. Ordinary doses may act as a sedative to some people.

The effects on the brain are usually noticed only after taking large quantities of alcoholic drinks. This effect is shown by the talkative, careless speech, the incoordinated, staggering gait, the coarse, uncontrolled laughter, and finally by coma with stertorous breathing (see poisonous effects).

Although the symptoms that result from large doses of alcohol are apparently those of increased brain activity, and this is the view held by some, the general consensus of opinion, based on actual psychological experiments, is that they result from lessened brain activity.

The normal civilized individual is under constant restraint, his thoughts, his speech, his acts, even his muscular movements have been so regulated and sensitized by training and intellectual development that his actions follow certain standards.

Alcohol begins by removing this normal restraint. The over-confidence in the ability to do, what the individual is manifestly unable to do, the uncalled-for movements, the incoherent speech, the coarse emotions, all bespeak a removal of restraint, or inhibition. It is evidently the result of diminished activity of the most highly developed and the most recently acquired mental functions of the brain. In other words, the effects of civilization are suddenly removed, the individual's actions approach those of uncivilized barbarians, with a low grade mentality.

The removal of the normal restraint accounts for the greater play of the purely physical motor functions of the brain. But even these actions do not occur in a systematized coordinated normal fashion, as is evident from the *boisterous* laughter, the *uncalled-for* tears, the apparently purposeless, *staggering* gait. The terminal muscular relaxation, the stupor and coma are conclusive effects of lessened brain action.

Effect on temperature: Alcohol lowers the temperature because the dilated blood vessels of the skin make the body lose heat.

Effect on nutrition: Alcohol has a distinct food value. About 90% of the alcohol absorbed is used up in the body. It combines with oxygen and is changed to carbon dioxide and water. In this way it provides energy for the activity of the body cells.

It is able, therefore, to take the place of such foods as carbohydrates (starches, sugars) and fats.

It is only suitable for temporary use, however, as in fevers; because if given for a long time, alcohol injures the various organs and tissues of the body. This may neutralize any effect it may have as a food.

Action on the kidneys: Alcohol slightly increases the flow of urine.

Excretion

About 90% of every dose of alcohol is used up in the body. The rest is rapidly eliminated by the kidneys, the lungs, and the skin, in the urine, the expired air, and the sweat.

Acute Alcoholism

Acute alcoholic poisoning results from drinking alcoholic liquors to excess. The effects constitute the familiar and far too common picture of drunkenness.

Symptoms

The effects may be divided into two stages: The stage of excitement, in which all the higher functions of the brain are lessened and the stage of stupor when all the brain actions are diminished.

Excitement Stage

The excitement may be increased and is often due to the brilliant surroundings in which alcoholic drinks are usually indulged. They may be entirely absent when taken under less inspiring conditions.

The individual is usually talkative; his thoughts flow freely, perhaps too freely. The speech may be brilliant, but it is careless, loud, coarse and incoherent. It is not logical and there is a poor choice of words or sentences. The words themselves may not be spoken distinctly. The individual becomes jolly, or boisterous and may suddenly become angry and quarrelsome. He may burst into a fit of tears or laughter. He often becomes coarsely sentimental and sensual. He usually moves about in an undignified manner, but his gait soon becomes unsteady and staggering. The face is usually flushed and the pulse and breathing are rapid.

When larger quantities are taken, the staggering gait becomes very marked, nausea and vomiting occur and the patient passes into—

The Stage of Depression

The individual falls into a deep sleep from which he can only be awakened with great difficulty (stupor). All the sensations are lessened and he may not feel pain. The muscles are relaxed; and this frequently saves him from a fracture after a severe fall. The face is blue, the breathing is slow and snoring in character (stertorous) and the pulse is rapid, strong and bounding. Frequently there is loss of control of the rectum and bladder.

When awakened, he is usually dull and stupid and falls heavily back again. Finally he passes into a condition of coma (a deep sleep in which he cannot be aroused) and collapse; with a rapid, weak thready pulse and dies.

The effects of overdoses of alcohol vary in different individuals. Some become sentimental, others quarrelsome, and still others fall asleep and have no excitement stage at all. Fatal results have occurred from a dose of 500 c.c. (1 pint) of whiskey.

Treatment

1. The stomach should be washed out.
2. Give artificial respiration if the breathing is slow and shallow.
3. Apply cold applications to the head.
4. Keep the patient warm.
5. Stimulants, such as strychnine, caffeine or a hot coffee enema are usually given.

Chronic Alcohol Poisoning, "Alcoholism"

Chronic alcohol poisoning results from habitually taking alcoholic liquors, especially distilled liquors, such as whiskey, gin, etc., which contain large percentages of alcohol. Although it may also occasionally result from the habitual use of beers or wines.

The injurious effects of alcohol are due to the fact that, when taken habitually, it dissolves some of the substances in the functioning cells of the various organs of the body. As a result, many of these cells are destroyed, and replaced by connective tissue. The organ thus affected is then unable to perform its work as well as before, and the patient suffers from various symptoms as a result of it.

The organs usually affected are the stomach, the liver, the blood vessels, the nervous system, and the kidneys.

When chronic alcoholism affects the stomach, chronic gastritis may result, with digestive disturbances. The effect of the prolonged use of alcohol on the liver produces cirrhosis of the liver, a condition where connective tissue replaces many of the cells of the liver, interfering with the circulation in the liver and abdomen, frequently resulting in accumulation of fluid in the abdomen. The latter condition is called ascites.

Arteriosclerosis, or hardening of the arteries, with symptoms of disturbance in the circulation and various organs of the body also result.

Myocarditis, a chronic inflammatory condition of the heart, in which the heart muscle fibers are replaced by connective tissue, may develop.

Chronic nephritis or Bright's Disease, which is due to the formation of connective tissue in the kidneys, may also result.

The brain and other parts of the nervous system may be affected by chronic alcoholism, producing various diseases of the nervous system, and even insanity.

Delirium Tremens

This is a special kind of temporary alcoholic insanity, which occurs in habitual drinkers, when they receive any shock. This may be the result of an injury, haemorrhage, an infectious disease, or a surgical operation. The symptoms are due to the sudden deprivation of the patient's usual amount of alcohol.

The most common symptoms are **hallucinations of the various senses, abnormal fears, tremors of the muscles and excitement.**

The patient often sees various animals, such as snakes, rats, dogs, etc., before him (hallucinations of sight) or he feels them creeping upon him (hallucinations of touch). He may hear voices and he is constantly talking to the imaginary persons who seem to be speaking to him. The patient

usually has twitching of the muscles of the extremities and is afraid of everybody about him.

Delirium tremens may be avoided by giving alcohol regularly to those patients who take it habitually, whenever they are subject to any shock, or when they are undergoing a surgical operation.

Uses

Locally, alcohol is used for the following effects:

1. To harden the skin and prevent bed sores.
2. As an antiseptic; 50-70% alcohol is the best preparation for such use.

Internally, alcohol is used in the following conditions:

1. As a cardiac and respiratory stimulant in cases of fainting, shock and collapse. Whiskey and brandy are the preparations used for this purpose.

2. To check a cold after exposure, whiskey or brandy in hot water relieves the congestion of the internal organs, by widening the vessels of the skin.

3. In acute infectious diseases, such as influenza, pneumonia, typhoid fever, septicaemia, or pyaemia, whiskey may be given as a food to reduce fever, to lessen nervousness and to induce quiet and sleep, and as a heart stimulant.

In such cases, the pulse will become slower, the temperature is lowered, the breathing becomes slower and deeper. The delirium and other nervous symptoms are lessened, and sleep is induced. The tongue becomes moist and the skin perspires more profusely.

When these effects are produced, alcohol is acting favorably. When, however, the pulse becomes rapid, the delirium, restlessness, uneasiness, and other nervous symptoms, are increased; the sleeplessness increases and the tongue and the skin remain dry, the alcohol is acting unfavorably, and the symptoms should be reported to the physician.

4. In convalescence, it is given as a food and for its soothing effect. In poisonous snake bite, alcohol, in the form of whiskey or brandy, should be given in very large doses.

5. Beer, brandy, or whiskey and water, may be given at bedtime to produce sleep, especially when the inability to sleep is due to mental work or nervous strain.

6. Brandy occasionally checks diarrhoea.

7. Dilute alcohol is a very valuable antidote for carbolic acid poisoning.

Tolerance

Individuals who take alcoholic beverages habitually, can take large quantities of such drinks without developing the usual

poisonous symptoms. This condition is known as tolerance for alcohol. To obtain effects in such individuals, very large doses must be given, often even more than twice the usual dose.

Administration

For local use the preparations of alcohol are used.

For internal use alcoholic liquors are principally used.

For temporary use and for immediate effects the distilled liquors, such as whiskey or brandy, are used. They are best given hot, undiluted. Ordinarily, however, brandy or whiskey is best given in a glass of vichy or seltzer filled with cracked ice, or with milk and egg in the form of a **milk punch** or **egg nogg**.

In collapse brandy and whiskey are frequently given hypodermically.

For continued use the fermented liquors such as wine or beer are used.

Preparations

For Local Use

Alcohol (Alcohol)

This contains 95% of ethyl alcohol by volume, and 92% by weight. It is used for rubbing the skin, to prevent bed sores. It is also used for burning purposes in alcohol lamps.

Absolute alcohol (Alcohol absolutum)

This contains 99% of ethyl alcohol. It is not ordinarily used, except by pharmacists and in laboratories.

Dilute alcohol (Alcohol dilutum)

This contains about 50% of ethyl alcohol by volume and about 41% by weight. This is the best preparation to use as an antiseptic.

For internal use

Alcoholic Beverages

Distilled liquors

Whiskey (Spiritus Frumenti)	15.0 c.c.	5½
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This contains about 44 to 50% of ethyl alcohol by weight, and about 50 to 56% by volume. Whiskey is made by distilling fermented grain or other starchy grains or vegetables. It should be at least four years old, because the fresh preparations are very irritating.

There are several kinds of whiskey:

American whiskey, made by distilling fermented rye and corn.

Scotch whiskey, made by distilling fermented barley.

Irish whiskey, made by distilling fermented potatoes.

Brandy or Cognac	15.0 c.c.	5 $\frac{1}{2}$
(Spiritus Vini Vitis, formerly Spiritus Vini Gallici)		

This contains about the same percentage of alcohol as whiskey. Brandy is made by distilling fermented unchanged juice of fresh grapes. It should be at least four years old, because the fresh preparations are too irritating. There are two kinds of brandy: pale and dark. The dark brandy contains caramel.

Brandy or cognac contains small quantities of tannin. It therefore has a tendency to contract mucous membranes. It is also more soothing to the stomach and intestines, and has a tendency to constipate and check diarrhoea.

Rum	15.0 c.c.	5 $\frac{1}{2}$
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Rum contains the same percentage of alcohol as whiskey. It is made by distilling fermented molasses.

Gin	15.0 c.c.	5 $\frac{1}{2}$
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Gin contains about the same percentage of alcohol as whiskey. It is made by distilling fermented rye, or barley, and flavoring with juniper berries. Because of the juniper which it contains, gin increases the flow of urine (diuretic).

Fermented Liquors

Wines

Wines are fermented liquors, made from grapes. Besides the alcohol, wines contain various acids, such as tartaric and tannic acids, and some volatile oils. There are several kinds of wines:

White wines	} Dry Sweet Sparkling
Red wines	

Dry wines are those which contain no added sugar.

Sweet wines are those which contain sugar which has been added.

Sparkling wines are those which are bottled before fermentation is complete. They contain carbon dioxide gas, and effervesce.

White Wine (Vinum Album)

White wines are made by fermenting grapes without the skins, stems or seeds. They contain 7 to 12% of alcohol.

The most important white wines are the following:

Dry white wines, such as rhine wines. They contain about 10% of alcohol.

Sweet white wines, such as tokay wines. These contain about 14% of alcohol.

Sparkling white wines, such as champagne, which is a French white wine. It is the most commonly used sparkling white wine and contains about 10% of alcohol.

Red Wines (Vinum Rubrum)

Red wines are made by fermenting colored grapes with the skins. They contain a larger percentage of alcohol than the white wines.

Dry Red Wines:**Claret**

This contains about 8–10% of alcohol.

Sherry (Vinum Xericum)

Sherry contains about 15–20% of alcohol and is often made artificially

Port Wine (Vinum Portense)

This is the strongest red wine, and contains about 20–40% of alcohol.

Sweet Red Wines:

The most commonly used sweet red wines are burgundy and madeira.

They contain from 6–20% of alcohol.

Sparkling Red Wines:

The most commonly used sparkling red wine is sparkling burgundy, which contains about 10% of alcohol.

Uses of Wines

The wines are not as stimulating as the distilled liquors, such as whiskey or brandy. They are better suited, however, for continued use. They aid digestion when taken during meals. Sweet wines, however, are apt to disturb digestion.

The wines contain tannic acid and contract mucous membranes (astringent action). They are therefore more constipating than the distilled liquors.

Sparkling wines, such as champagne, are soothing to the stomach when given in small doses. They are not as stimulating to the heart. Champagne causes intoxication rapidly, in spite of the small quantities of alcohol which it contains. When taken in larger quantities it is apt to cause headache, pain in the stomach, nausea, hiccough, etc. Champagne should be given ice cold, in teaspoonful doses. It is particularly valuable in cases of nausea and vomiting, for example, after an operation. It is not so effective when the gas escapes. This may be avoided by inserting a special tap in the cork, and keeping the bottle on ice, upside down.

Beers

Beers are made by fermenting starchy grains. They are usually made by fermenting brewed barley malt (barley which has been made to grow by artificial means and the growth stopped), with hops.

Ale, porter and stout are the various kinds of beers that are used. They contain about 3–10% of alcohol with a large amount of solids, mainly sugar and starches. Because of the starches and sugar which they contain, beers are very nutritious. They occasionally disturb digestion, however.

Since the advent of National Prohibition, beer, ale and stout may not be prescribed.

Liqueurs are preparations of volatile oils containing alcohol. Many of them contain sugars. Kirchwasser is a liqueur which contains very small quantities of hydrocyanic acid.

Various essences of flowers, such as eau de cologne, contain large amounts of alcohol. Cases of alcoholism occasionally occur from drinking eau de cologne, especially among women.

WOOD ALCOHOL (METHYL ALCOHOL)

Wood alcohol is made by the destructive distillation of wood. It is very inflammable, and because it is cheap it is used as a solvent for various substances.

Wood alcohol is not used in medicine, but it is of interest because of its poisonous effects. This results from substitution by unscrupulous manufacturers, of wood alcohol for ordinary alcohol in the manufacture of essences such as soda water flavors, Jamaica ginger, witch hazel, bay rum, cologne, etc. Many patent medicines contain wood alcohol. Since the advent of prohibition the number of cases of wood alcohol poisoning have greatly increased because many beverages are prepared with wood alcohol as it is difficult to obtain ordinary alcohol.

Wood Alcohol Poisoning

There are two forms of wood alcohol poisoning: the acute poisoning and the chronic poisoning. The acute symptoms follow drinking of intoxicating or other liquors containing wood alcohol. The chronic symptoms result from the continued use of local applications containing wood alcohol.

Acute Wood Alcohol Poisoning

Symptoms

The symptoms are due to the fact that wood alcohol is not oxidized in the body as is ordinary alcohol, but affects principally the brain and nerves.

The symptoms begin like an ordinary alcoholic intoxication with excitement and exhilaration. This is followed by nausea, vomiting, dizziness, headache, dilated pupils, and delirium.

Persistent coma and death may follow within a few hours or a few days. The patient may recover from the acute symptoms but may go blind from destruction of the optic nerve (optic neuritis). Blindness has resulted from as little as five teaspoonfuls and death from half a pint of wood alcohol.

Treatment

1. The stomach should be washed out.
2. Give artificial respiration.
3. Strychnine, caffeine and other stimulants are given.

Chronic Wood Alcohol Poisoning

Prolonged use of wood alcohol may cause blindness from destruction of the optic nerve (optic nerve atrophy). This may occur from its internal use or from external applications of various toilet preparations.

There are numerous other alcohols such as **propyl alcohol**, **butyl alcohol**, **amyl alcohol**, etc., which result in the distillation of ordinary wood alcohol.

CHAPTER XXII

GENERAL ANAESTHETICS

Anaesthetics are drugs used to produce insensibility to pain, so as to enable a surgical operation to be performed painlessly. The anaesthetics are divided into two groups:

1. **General Anaesthetics**
2. **Local Anaesthetics**

General anaesthetics are drugs which produce insensibility to pain and a loss of all sensations throughout the body. No sensory impulses are then received by the brain, and the patient becomes unconscious and falls asleep. The effects of the general anaesthetics result from their circulation in the blood.

Local anaesthetics are drugs which abolish sensations only on the particular area of the body where they are applied. Since they do not abolish all sensory impulses, they do not produce unconsciousness.

In this chapter we shall consider only the general anaesthetics.

ETHER (AETHER)

Ether is a colorless liquid formed by the combination of sulphuric acid and alcohol. It evaporates very easily, is very inflammable and has a very disagreeable odor and a burning taste. Ether was first used as an anaesthetic by an American dentist, Dr. Morton, in 1842.

It is usually given by inhalation through a mask or specially constructed apparatus, to produce insensibility to pain. Its effects are quite similar to those of alcohol, which was formerly used in excessive doses to produce a mild anaesthesia. Chemically, ether is closely related to alcohol, being formed when alcohol is combined with oxygen. It should be remembered that the anaesthetic effect of ether is its poisonous effect, but the anaesthesia does not produce dangerous symptoms unless very large quantities are given.

Appearance of the Patient

Ether Anaesthesia

The most striking effect that may be noticed when ether is given to produce anaesthesia, is that the patient struggles and talks a great deal. It is customary, therefore, to divide the anaesthetic effects of ether into three stages; according to whether they occur before the patient struggles, during the time of struggling, or after this stage has occurred. A fourth stage is a stage of anaesthesia accompanied by complete relaxation of the muscles. The stages of ether anaesthesia are the following:

1. The first stage, or stage of local irritation and diminished sensation.
2. The second stage, or stage of excitement.
3. The third stage, or stage of partial anaesthesia and stupor.
4. The fourth stage, or stage of complete anaesthesia and muscular relaxation.

Symptoms of the First Stage of Anaesthesia

The patient has probably undergone various preparations for the operation, and has pictured in his mind various ideas of pain and suffering that the operation might produce. This makes him quite nervous and anxious, and the pulse quite rapid. He therefore regards every act of the doctor or nurse with suspicion.

When the mask is applied to the face, the difficulty of obtaining air causes a **choking sensation**, and the inhalation of the irritating ether causes a burning pain in the throat, coughing, and a **profuse flow of saliva**. Soon there is a feeling of warmth all over the body and the sensations become dulled. **The sense of touch is blunted, objects are seen through a mist, and sounds appear to be at a distance. Ringing, hissing or roaring sounds** are sometimes heard. Some patients feel as if they are falling.

The muscles become stiff and the arms are held rigid. **The face is flushed**, the pupils are dilated, but they react to light. The pulse is rapid, and the breathing is rapid and irregular on account of the coughing and choking sensation. These effects last for about five or ten minutes and are soon followed by—

The Symptoms of the Second Stage or Excitement Stage

This stage begins with **movements of the arms**. The patient tries to push the mask away, and attempts to get up. Many patients **struggle violently**, others **shout, sing, groan, or burst**

into fits of laughter. Some patients repeat words incoherently and act as if they were drunk. The effects often vary with the mode of life and the temperament of the individual. Religiously inclined persons may sing hymns or pray; others become abusive; they swear or fight. Some become jolly, they laugh and sing. Many become emotional, and some have fears of injury or death.

During this stage the patient still feels pain. **The pulse is rapid, the skin is flushed,** often blue, and the breathing is irregular because of the struggling. The pupils are dilated, they react to light, and sometimes there are lateral movements of the eyeballs. The symptoms last for a few minutes, the struggling then becomes lessened, the shouting and talking become indistinct, the breathing becomes very shallow and the patient passes into—

The Third Stage or Stage of Partial Anaesthesia

The excitement is now over and the patient is asleep, but he can be aroused with difficulty. He does not feel pain, but he winces when an incision is made. The muscles are still quite rigid. The breathing is still deep and regular, the pulse is strong, and regular, the face is flushed and the pupils are contracted. If more ether is given, these symptoms are followed by—

The Fourth Stage, or the Stage of Complete Anaesthesia

The patient now becomes calm, quiet and unconscious, and cannot be aroused. All sensibility is gone. **The muscles are relaxed** so that when an arm or leg is lifted, it falls limply back again. The reflexes disappear, so that when the skin is touched or incised, no response or movement is produced. The winking of the eyelids which occurs when the eye is touched, often remains for some time, however.

The pulse still remains rapid and strong, though it is slower than during the first and second stages. **The breathing is deep and rapid** and is often snoring in character. The face is flushed. The pupils are usually slightly dilated, and react sluggishly to light and accommodation. There is often a constant flow of saliva and mucus in the mouth and throat.

This stage of anaesthesia may be kept up for hours by judiciously pouring small quantities of ether on the mask.

After Effects

When the ether is stopped, the patient may again become somewhat excited and talkative, he feels nauseous and vomits, and perspires excessively. He then slowly regains consciousness, often remaining asleep for a few hours before consciousness is

regained, and complains of headache, dizziness and thirst, for hours afterward.

ACTION

Local action: Applied to the skin, ether evaporates so rapidly that it makes the skin feel cool. It also slightly numbs the sensation, acting as a mild local anaesthetic.

Internal Action

In the mouth: Ether has an unpleasant burning taste, and increases the flow of saliva by local irritation of the mucous membrane.

In the stomach: It increases the secretions of the mucous membrane, and slightly checks the formation of gas (carminative action) if given diluted.

In the intestines: It causes redness and swelling of the mucous membrane with profuse secretions of mucus. It relieves colic and is used to destroy intestinal worms (anthelmintic action).

Action after Absorption

Ether is absorbed into the blood in a few minutes, through the mucous membranes of the lungs, stomach or intestines. After absorption it affects principally the brain, the heart and the respiration.

Action on the brain: When given by mouth the compound spirit of ether has a tendency to soothe nervousness. The effects of ether on the brain are evident in the symptoms occurring when anaesthesia is induced. They are quite similar to those of large quantities of alcohol. The ether first lessens the higher intellectual functions and then all the functions of the brain except the vital ones.

The uncontrolled talkativeness, the constant movements, the dreams occurring during the excitement stage, are all evidence of removal of restraint; from the speech, the motor and the imaginative center of the brain. The loss of sensibility, the unconsciousness and the relaxation of all the muscles, which follow the excitement stage, and which are present during the stage of anaesthesia, are the result of the diminished activity of the sensory and motor areas of the brain. The unconsciousness results because the appreciation of sensations is lessened.

Action on the spinal cord: The reflex action, which is the type of action prevalent in the spinal cord, is at first increased, but soon lessened, and then entirely abolished by ether. Many reflexes, however, such as the reaction of the pupil to light, the movements resulting when the sphincter is stretched, remain for a long time.

Action on the respiration: Ether makes the breathing faster and deeper. During the excitement stage of anaesthesia, however, the breathing may be irregular, because of the struggling and contractions of the muscles for breathing.

Action on the lungs: Ether increases the secretions of the mucous membranes of the bronchi and lungs.

Action on the circulation: Ether makes the heart beat stronger and faster. It contracts the blood vessels and increases the blood pressure. It dilates the blood vessels of the skin, however.

The characteristic pulse of ether is therefore rapid and strong. During the third stage of anaesthesia, the rate of the pulse is about normal, or a little above normal. As the anaesthesia progresses, however, the pulse gradually becomes weaker.

Action on the blood: Ether has a tendency to destroy red blood corpuscles.

Action on the muscles: When ether is given as an anaesthetic all the muscles are relaxed in the fourth stage.

Action on the pupils: During the first and second stages of anaesthesia, the pupils are dilated because of the excitement. During the third stage, the pupils are contracted, but they react to light, and in the fourth stage they are slightly dilated.

Action on the kidneys: Ether is somewhat irritating to the kidneys. After a prolonged anaesthesia, it often causes albumin in the urine.

Excretion

Ether is very rapidly eliminated from the body, in the expired air of the lungs, usually in about a half hour. When given as an anaesthetic, it is entirely excreted in about 24 hours; the breath has its unpleasant odor during that time.

Idiosyncrasies

1. In some individuals, and in children, there may be no excitement stage.

2. Patients who are accustomed to taking alcoholic liquors habitually, require larger quantities of ether to produce anaesthesia. These patients usually struggle a great deal in the second stage of anaesthesia.

3. In some individuals, very small quantities may cause poisonous effects.

Poisonous Effects or "Ether Collapse"

Although the anaesthetic effect of ether is a poisonous effect,

dangerous symptoms or ether collapse, usually results when too much ether is given to produce anaesthesia.

Symptoms

1. The first symptom which indicates that too much ether is being administered, is **slow, shallow and gasping breathing**.

2. The face then becomes blue and cyanotic and the breathing stops

3. The pulse may not become affected, but it soon becomes weak and irregular.

4. The pupils are widely dilated, and do not react to light. The pulse gradually grows weaker, and death finally results from respiratory paralysis.

A number of mechanical difficulties are sometimes encountered during anaesthesia which may cause dangerous symptoms such as the following:

1. The relaxed muscles of the tongue may cause the tongue to fall back and obstruct the breathing.

2. In some cases, continued vomiting of the contents of the stomach, or the accumulation of mucus in the mouth and throat during deep anaesthesia, may cause food particles or mucus to enter the lungs and cause asphyxia. This can be avoided by constantly keeping the mouth thoroughly mopped out.

Treatment

1. Stop anaesthesia; take the mask away.

2. Pull the tongue forward.

3. Give artificial respiration.

4. Elevate the foot of the table.

5. Stretch the sphincter of the rectum to induce breathing by the reflex action thus produced.

6. Give heart and respiratory stimulants such as caffeine, strychnine, atropine, etc.

Usually, if the collapse is recognized early, these measures will revive the patient.

Dangers Following Anaesthesia

The most common condition that may occur after ether anaesthesia is **pneumonia**. This may result from the irritating effect of ether on the lungs.

Preparations for Anaesthesia

Before administering ether, the following measures should always be carried out, but the nurse should receive these or similar orders from the surgeon.

1. Move the bowels by a cathartic, about twelve hours before the operation, and give an enema the morning of the day the patient is to be operated upon.

2. Do not give any food or drink for about twelve hours before the operation. This often prevents vomiting during anaesthesia.

3. Catheterize the patient before the operation.

4. **Remove all plates of false teeth**, so that the patient will not swallow them during the anaesthesia.

5. When the anaesthesia is begun, the eyes should be covered with a piece of gauze, and the face protected with vaseline to avoid the irritating effects of the ether fumes.

After Care of Anaesthesia

Nausea and vomiting, excessive thirst, headache, gas pains and pain in the back are the usual symptoms which follow anaesthesia, for a few days.

The nausea and vomiting are sometimes relieved by small pieces of ice held in the mouth, or by sipping water with sodium bicarbonate in it. Occasionally, it is necessary to wash out the stomach. When the patient vomits, the head should be turned to the side, to prevent the vomited material from passing down the trachea.

The intense thirst may be relieved by rinsing the mouth or by ice pills. Some surgeons allow the patient to have small quantities of warm or cold water, while others allow a large drink.

The headache may be relieved by an ice bag, or a cold compress to the head.

The gas pains may be relieved by peppermint tea, by the insertion of a rectal tube or by a rectal irrigation.

The pain in the back may be relieved by placing more pillows under the patient, by changing the position or by rubbing the back.

METHODS OF ADMINISTERING ANAESTHESIA

To produce anaesthesia, ether is given by inhalation through a mask held over the nose and mouth, in the following ways:

In giving an anaesthetic, it is important that the drug be administered very slowly. The breathing and pulse should be watched very carefully throughout the anaesthesia, so as to avoid dangerous symptoms.

The Open Method or Drop Method

The ether is poured drop by drop on a mask covered with gauze, and the patient is then allowed to inhale the ether vapor which is thoroughly mixed with air.

The Closed Mask Method

This method is gradually being abandoned. The ether is given through a cone saturated with ether, which is thus mixed with very little air.

Gas Ether Method

This is the most commonly used method. The patient is first given nitrous oxide gas, and then ether. In this way, many of the unpleasant effects of ether, and the excitement stage, are avoided.

There are numerous types of apparatus for giving ether by this method, many of which have various advantages, such as warming the vapor, etc.

Other Methods of Administering Anaesthesia

Ether is also occasionally given as an anaesthetic by the rectum, by means of a specially constructed apparatus.

A method has been devised for producing anaesthesia by giving ether intravenously. The ether is dissolved in salt solution, which is injected directly into a vein.

Uses

Besides its use as an anaesthetic, ether is used for the following effects:

1. To check convulsions (given by inhalation).
2. As a carminative, to lessen the formation of gas in the stomach and intestines.
3. To relieve spasm, such as an attack of asthma, angina pectoris or shortness of breath, especially when formation of gas in the stomach is the cause.

Preparations

(Ether	0.5-1.0 c.c.	m. viii-xv
(Aether)		

This contains 96% of ether, and is used principally as an anaesthetic. The dose of ether for anaesthesia varies with the patient, and the degree of anaesthesia desired.

Spirit of Ether	2.0-4.0 c.c.	℥½-i
(Spiritus Aetheris)		

This consists of 32 parts of ether and 68 parts of alcohol.

Compound Spirit of Ether	2.0-4.0 c.c.	℥½-i
(Spiritus Aetheris Compositus)		
(Hoffman's Anodyne)		

This contains 32% of ether, alcohol and other substances known as ethereal oils. It is used principally to check the formation of gas in the stomach and intestines, and as a remedy for fainting. It is usually diluted with cold or iced water.

CHLOROFORM

Chloroform is a colorless non-inflammable fluid, which evaporates easily, but not as rapidly as ether. It is formed by the combination of alcohol with chlorine. Chemically, it is a compound of methane (marsh gas) with chlorine, forming trichlor methane or chloroform. It is used principally as an anaesthetic. Chloroform is used like ether, principally for its poisonous effect, which is anaesthesia, but dangerous symptoms do not occur unless excessive quantities are given.

Chloroform Anaesthesia

When chloroform is given as an anaesthetic, the symptoms it produces can be divided into four stages as in ether anaesthesia.

During the first stage, the patient is nervous, anxious, and the sensations are dulled, but the chloroform is not irritating and is more pleasant to take than ether. The pulse is usually rapid.

The second stage develops very rapidly, and may be entirely absent. The excitement, talkativeness and struggling, however, are usually slight, and last for a very short time.

The stage of anaesthesia, develops very rapidly with chloroform. The patient is calm, quiet and unconscious. **The breathing is slow and shallow, the rate of the pulse is normal**, perhaps somewhat slower but weak. The face is pale, and the pupils are contracted, but they react to light. All sensibility and the reflexes are gone, and the muscles are relaxed.

With chloroform, anaesthesia is induced more rapidly than with ether, usually in about five or ten minutes. **The muscles become relaxed sooner, the pulse is weak and slower and the breathing is shallow.**

ACTION

Local action: Applied to the skin, it is irritating and may cause a burn. If it is prevented from evaporating, it may form a blister. **On mucous membranes:** It is irritating.

Internal Action

In the mouth: It has a hot sweetish taste and it increases the flow of saliva.

In the stomach: Dilute solutions cause a feeling of warmth and check the formation of gas (carminative action). They increase the secretion and the peristalsis. They are usually absorbed from the stomach and do not enter the intestines.

Action after Absorption

Chloroform is absorbed into the blood through the mucous membrane of the stomach in about fifteen minutes, when given by mouth. When inhaled as an anaesthetic, it enters the blood from the mucous membrane of the lungs still more rapidly. After absorption it affects principally the brain, the heart and the respiration.

Action on the brain: Chloroform produces the same effects on the brain as ether does. They are evident in the symptoms occurring when anaesthesia is induced. It causes progressive depression of the brain centers, beginning with the higher intellectual centers, followed by rapid depression of the other centers as well. The result of this action is a very short preliminary stage of excitement and talkativeness, followed by unconsciousness, loss of sensation and relaxation of the muscles.

Action on the spinal cord: Chloroform at first increases, and then lessens the reflex action throughout the body.

Action on the respiration: It makes the breathing slower and shallower.

Action on the lungs: Chloroform does not increase the secretions of the bronchi as much as ether does.

Action on the circulation: Chloroform makes the heart beat slower and weaker, by weakening the contractions of the heart muscle. It widens the blood vessels and lowers the blood pressure. **The chloroform pulse is slow and weak.**

Action on the blood: Chloroform has a tendency to destroy red blood corpuscles.

Action on the pupil: The pupil is contracted, but it reacts to light and accommodation.

Action on the muscles: Chloroform relaxes all the muscles of the body when given as an anaesthetic.

Action on the kidney: It is distinctly irritating to the kidney, and changes some of the constituents of the kidney cells to fat. It often causes albumin in the urine.

Excretion

Chloroform is rapidly eliminated, mainly by the expired air of the lungs; though some of it is also excreted by the urine and the perspiration.

Poisonous Effects

Chloroform poisoning occurs in two forms:

1. **Acute Chloroform Poisoning.**
2. **Delayed Chloroform Poisoning.**

Acute Chloroform Poisoning

Acute chloroform poisoning usually results when too much chloroform is given as an anaesthetic; or in susceptible individuals, from very small quantities; even from a few drops.

Sudden Chloroform Death

Sudden death occasionally occurs from chloroform, in susceptible individuals, even when only a few drops are administered for anaesthesia.

This sometimes happens during the first stage of anaesthesia. **The pulse becomes very slow and weak, the face turns pale, the breathing becomes very shallow and slow, the pupils are widely dilated, and the patient dies in a few minutes.**

This very unfortunate occurrence is the result of the coughing and burning pains in the throat which occur during the first stage of anaesthesia. This irritation in the throat affects the Vagus nerve in a reflex manner. The function of this nerve is to slow the heart, and when it is suddenly stimulated the heart stops beating.

In a similar manner, emotional or other impulses sometimes cause fainting, a condition in which the heart stops beating for a few moments, but soon recovers again. In sudden chloroform death, however, the heart muscle is poisoned by the chloroform; so that after it has suddenly stopped beating, it does not contract again, and death results.

If atropine is given before chloroform anaesthesia, it occasionally acts as a safeguard against this dreaded accident. The atropine paralyzes the nerve endings of the Vagus nerve in the heart, and prevents impulses which tend to slow the heart from reaching it.

When sudden chloroform collapse occurs, it is usually treated by giving atropine, adrenalin and other heart stimulants hypodermically, and massaging the chest over the heart. Every now and then patients recover after such vigorous treatment.

Symptoms of Chloroform Collapse

When too much chloroform is given during anaesthesia, the following symptoms usually result, in the order of their onset.

1. The pulse becomes slow, weak and irregular, usually about 50 or 40 to the minute.
2. Slow and shallow breathing.
3. Pallor of the skin.
4. The pupils are widely dilated, and do not react to light or accommodation.

5. The pulse and breathing become still slower, and the patient dies from paralysis of the heart.

Treatment

1. Stop the anaesthesia, and take the mask away as soon as the slow and weak character of the pulse is noticed.
2. Stimulants such as atropine, caffeine, epinephrine and camphor are usually given.
3. Give artificial respiration.
4. Elevate the foot of the table.
5. Keep the patient warm.

Delayed Chloroform Poisoning

This form of chloroform poisoning occurs infrequently. The symptoms appear about a few days after the anaesthetic has been administered. It is due to the destruction of many of the cells of the liver, kidneys, and heart, which then become filled up with fat globules (fatty degeneration).

Symptoms

1. Nausea and vomiting; the vomited matter containing bile.
 2. Jaundice.
 3. Delirium and convulsions.
 4. Scanty urine, which contains albumin, and two substances characteristic of this condition, **leucin** and **tyrosin**.
 5. Collapse (slow, weak pulse, slow, shallow breathing, etc.).
- The patient usually dies in a few days from profound collapse.

Administration

Chloroform is usually given by inhalation, by means of a mask covered with gauze, which is held over the patient's nose and mouth. A few drops are poured on the mask and allowed to mix thoroughly with air. Dangers of chloroform are best avoided by pouring it very slowly, a drop at a time, and allowing the vapor to thoroughly mix with air.

The nurse is often called upon to give chloroform during labor, in obstetrical cases. Very small quantities should be used in such cases. It is only necessary to administer a few drops whenever the patient has severe pains to allay their severity. Complete anaesthesia is not desired in these cases, since this lessens uterine contractions and retards the birth of the child. The pulse and breathing should be watched very carefully throughout the anaesthesia.

Uses

Besides its use as an anesthetic, chloroform is given:

1. To stop convulsions (by inhalation).
2. To check diarrhoea and to lessen colic (by internal administration).
3. Chloroform liniment is frequently used as a local application to relieve pain.

Preparations

For Internal Use:

Chloroform (Chloroformum)	0.06-1.0 c.c.	m. i-xv
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The dose of chloroform for anaesthesia varies with the patient and the degree of anaesthesia desired.

Chloroform should always be kept in brown bottles, as it is readily decomposed into dangerous substances, by the action of light.

Spirit of Chloroform (Spiritus Chloroformi)	2.0-4.0 c.c.	m. xxx-3i
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This contains 10% of chloroform.

Emulsion of Chloroform (Emulsum Chloroformi)	15.0-30.0 c.c.	℥½-i
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This contains 4% of chloroform.

For Local Use:

Chloroform Liniment
(Linimentum Chloroformi)

This consists of soap liniment and chloroform, and contains 30% of chloroform.

Compound Chloroform Liniment
(Linimentum Chloroformi Compositus)

This contains chloroform, oil of turpentine, laudanum, tincture of aconite, and soap liniment.

COMPARATIVE ACTION OF ETHER AND CHLOROFORM

ETHER

CHLOROFORM

- | | |
|---|--|
| 1. Inflammable | 1. Not inflammable |
| 2. Cools the skin | 2. Burns the skin |
| 3. Unpleasant to take | 3. More pleasant to take |
| 4. Anaesthesia induced with larger quantities, and not as deep. | 4. Deeper anaesthesia induced with smaller quantities. |
| 5. Marked excitement stage | 5. Little or no excitement stage |
| 6. Pulse rapid and strong | 6. Pulse slow and weak |
| 7. Skin bright red in color | 7. Skin pale |

8. Suitable in cases where the heart action is weak or where the kidneys are diseased.

8. Suitable in cases where the lungs are diseased, or in alcoholic habitués.

Dangers

9. Respiratory collapse

9. Cardiac collapse

After Effects

10. More vomiting

10. Less vomiting

11. Apt to cause pneumonia

11. Apt to cause delayed chloroform poisoning

ETHYL CHLORIDE (AETHYLIC CHLORIDUM)

Ethyl chloride, chloride of ether or kylene, is formed by the action of hydrochloric acid gas on alcohol. It evaporates very easily. It usually comes in special glass containers, with a long, pointed tip, which is broken off or unscrewed. A fine stream of vapor then shoots out, which is directed on the mask; or, for local anaesthesia, on the skin.

ACTION

Local action: Because it evaporates very easily, ethyl chloride freezes the skin over which it is applied, producing local anaesthesia of the part. Minor surgical operations can be performed under such local anaesthesia. It should be sprayed on the part to be operated until the tissues become white and hard; if the spraying is continued after this effect is obtained it is apt to cause irritation.

Anaesthetic Action

Ethyl chloride is also used as a general anaesthetic. It produces anaesthesia very rapidly, usually in about 1 to 5 minutes.

Its effects are similar to those of chloroform, but it does not cause complete muscular relaxation. The pulse is slow and weak, and the breathing is deep. The patient usually recovers from the effects very rapidly. It is usually given to start an ether anaesthesia. It is not suitable for prolonged use, because it weakens the heart even more than chloroform, and it does not cause complete muscular relaxation.

ETHYL BROMIDE (AETHYLIC BROMIDUM)

Ethyl bromide, or bromide of ether, is a colorless liquid which evaporates easily. It has a disagreeable, sweetish taste, and an ethereal odor. It acts like ethyl chloride, but it is not used very much.

ANAESTHETIC MIXTURES

The following preparations are mixtures of various anaesthetics. They are said to have various advantages over a single anaesthetic.

A. C. E. Mixture

This consists of alcohol 1, ether 2, chloroform 3, parts by volume.

Anaesthol

This is a mixture of chloroform 36%, ether 47%, ethyl chloride 17%.

It is said to have the same boiling point as the blood, and therefore to be easily excreted. The dangers of chloroform are thus said to be avoided.

When anaesthol is given, the ether and the ethyl chloride evaporate more quickly than the chloroform.

The anaesthetist is then giving concentrated chloroform instead of a diluted mixture. Dangerous symptoms are apt to follow its use, especially in warm weather, since the ether and other ingredients evaporate more easily than the chloroform.

NITROGEN MONOXIDE OR NITROUS OXIDE GAS (LAUGHING GAS)

Nitrogen monoxide or nitrous oxide gas is a colorless gas without any odor. It is made by distilling ammonium nitrate. The gas is passed through water, and collected in small metal cylinders, in which it usually comes for practical use. It is the safest and most pleasant anaesthetic known.

Appearance of the Patient Nitrous Oxide Anaesthesia

A few seconds after inhaling nitrous oxide gas, the patient usually feels **rushing, drumming or hammering noises in the ears**, the sight becomes indistinct, and he has a feeling of warmth and comfort all over the body. **The patient constantly moves the arms and legs about**, he is lively, very jolly, and may burst out into fits of laughter (hence the name "laughing gas"). These symptoms last for about 2 or 3 minutes and then the patient feels drowsy, falls asleep, and loses all sensibility.

During the anaesthesia, the face is dark red in color, often blue, the breathing is deep and snoring in character, the pulse is slow, strong and tense, and **the blood pressure is very high**. If the nitrous oxide is judiciously mixed with air, or oxygen, the anaesthesia can be kept up for a half to one hour.

As soon as the mask is taken away, however, the patient becomes conscious in about 1 to 3 minutes, and has no after effects, except perhaps a slight headache, which may persist for a few hours.

Nitrous oxide does not relax the muscles, so that prolonged abdominal operations cannot be performed under its anaesthesia. It should not be given when the blood pressure is high.

ACTION

Nitrous oxide is a gas which is only given by inhalation to produce anaesthesia. It is absorbed into the blood from the

lungs almost immediately. The symptoms which it produces are due to its action on the brain, the blood and respiration.

Action on the brain: The noises in the ears, the movements of the extremities, the laughter, are all evidence of increased activity of the brain. These symptoms last for a few minutes and are almost immediately followed by symptoms of lessened brain activity; such as sleep and loss of sensation.

Action on the respiration: Nitrous oxide gas, by taking the place of oxygen in the lungs and in the blood, prevents the haemoglobin from obtaining its necessary oxygen. The patient then suffers from asphyxia. This makes **the breathing deep and snoring in character** (stertorous), **and the blood becomes blue in color** so that the face has a purple or blue color during anaesthesia.

Action on the heart: The slow, strong pulse and high blood pressure are the result of the asphyxia, and are not due to any effect on the heart or blood vessels.

Excretion

Nitrous oxide gas is eliminated from the body in a few minutes by the expired air.

Poisonous Effects

When too much nitrous oxide is given, the following symptoms are produced, because the haemoglobin is unable to obtain its necessary oxygen. The blood is then impure and is poisonous to the brain and other organs of the body.

Symptoms

1. The face is blue in color (cyanosis).
2. The breathing is difficult and deep.
3. Slow, strong pulse, with very high blood pressure.
4. Convulsions.

These symptoms disappear as soon as the nitrous oxide is stopped.

Administration

Nitrous oxide gas is usually given by inhalation by means of a specially constructed apparatus, consisting of a mask attached to a large rubber bag, which is filled with the gas from a metal container.

Uses

Nitrous oxide gas is used to produce anaesthesia for short surgical operations, and to begin ether anaesthesia, so as to avoid its unpleasant symptoms and excitement stage.

It is frequently given together with oxygen for prolonged anaesthesia.

ETHYLENE

Ethylene is a gas which is used as an anaesthetic like nitrous oxide.

It produces anaesthesia rapidly, with relaxation of the muscles but without cyanosis. It has a very offensive odor, and may explode in the presence of an electric spark or a flame. Like nitrous oxide it is given together with oxygen.

CHAPTER XXIII

HYPNOTICS

Hypnotics, soporifics, narcotics or somnifacients, are drugs which lessen the activity of the brain, and produce sleep, or unconsciousness.

Their effects are similar to those of the general anaesthetics, but they are milder, more lasting, and do not relieve pain. The hypnotics are usually given by mouth and are slowly absorbed; their effects lasting for several hours.

The most efficient hypnotic is chloral.

The hypnotics may be divided into three groups, according to the rapidity with which the effect is produced.

Rapid	Slow	Intermediate
Chloral type	Sulfonal type	Veronal or Barbital group
Paraldehyde		Luminal
Morphine	—	Trional
		Allonal
		Bromides

Mode of Action

Our consciousness depends upon the impulses received from our surroundings through the various senses. Hypnotics, by lessening the activity of the brain, also lessen the activity of its sensory areas, so that fewer impulses are received from our environments, and unconsciousness or sleep results.

When the activity of the sensory areas is lessened, the appreciation of pain, one of the sensations, is also lessened; so that many of the hypnotics relieve pain (analgesic action) besides producing sleep. They also lessen mental activities and restlessness.

MORPHINE AND OPIUM

Morphine and opium produce sleep when the patient is unable to sleep on account of pain. Their effects have been more fully described under their more important actions. (See page 274.)

BROMIDES

The bromides produce sleep when the patient is unable to sleep on account of nervousness or emotional excitement.

CHLORAL

Chloral is an oily, colorless liquid made by the combination of chlorine gas with absolute alcohol. In this form it is not used in medicine but when chloral is combined with water, crystals of **chloral hydrate** are formed. This is the preparation ordinarily used.

Appearance of the Patient

About 5 to 15 minutes after an average dose of chloral hydrate is given, the patient feels tired and drowsy, and soon falls asleep. The sleep lasts for about five to eight hours. It resembles the natural sleep, and the patient can be easily awakened; by pain, or by loud sounds, or when touched. During the sleep, the pulse and breathing are slow, and the pupils are contracted.

When the patient awakes, he may complain of a little headache and dizziness, and may be somewhat confused.

ACTION

Local action: Applied to the skin, chloral is irritating and may cause redness and even blisters. It also acts as an antiseptic, checking the growth of bacteria.

Internal Action

In the mouth it has a hot, burning taste.

In the stomach and intestines: It occasionally causes nausea and vomiting.

Action after Absorption

Chloral is very rapidly absorbed into the blood through the mucous membrane of the stomach and intestines; usually in about 5 to 15 minutes. After absorption, it affects principally the brain, the heart, and respiration.

Action on the brain: Chloral lessens the activity of the brain, producing sleep, but it does not relieve pain.

Action on the spinal cord: The reflex actions of the spinal cord are lessened by chloral. External stimuli applied to various parts of the body therefore produce a slow response.

Action on the heart: Chloral makes the heart beat slower and weaker by weakening the contractions of the heart muscle. The pulse then becomes slower and weaker.

Action on the respiration: The breathing becomes somewhat

slower and shallower, because fewer impulses for breathing are sent out from the respiratory center in the medulla.

Effect on the temperature: Chloral lowers the temperature several degrees by lessening muscular contractions, so that less heat is produced.

Excretion

Chloral is eliminated from the body mainly in the urine in several hours.

Idiosyncrasies

Chloral often causes the following unusual effects:

1. Flushed face and neck.
2. Eruptions: large, red areas on the skin, which are often distinctly raised above the surface (wheals). The eruptions often peel (desquamate).
3. Nausea and vomiting.
4. Headache and excitement.

The chloral should be stopped when these symptoms appear.

The danger is usually over when the pulse is above 60 and is regular and strong.

Tolerance

If chloral is taken habitually, the patient becomes accustomed to the drug, so that large doses may be taken without producing any poisonous effects.

Poisonous Effects

Acute chloral poisoning is a condition which may result when an overdose of chloral is given medicinally.

In giving chloral, the patient must be carefully watched, and the pulse should be taken very frequently; as sudden heart failure from chloral is not at all uncommon, even from a single dose.

Symptoms

1. Very slow and shallow breathing.
2. Slow, weak, irregular pulse with low blood pressure.
3. Subnormal temperature.
4. Stupor, followed by coma.
5. Collapse.

Death usually results from paralysis of the heart and breathing. The smallest fatal dose is 2.0 Gms. (grs. xxx).

Treatment

1. The stomach should be washed out.
2. Give artificial respiration.
3. Keep the patient warm and quiet. Excitement may be fatal.
4. Atropine, caffeine, strong coffee, or alcohol are usually given to increase the action of the heart and respiration.

Chloral Habit

Habitual use of chloral often causes symptoms resembling those of chronic alcoholism. It causes degeneration of some of the organs in the body, such as the liver and kidney. The following symptoms may result from this condition:

1. The patient feels melancholic and "blue."
2. Wakefulness and nervousness at night.
3. Gastric symptoms and constipation.
4. Eruptions on the body.
5. Muscular weakness.

If the drug is suddenly stopped, symptoms resembling delirium tremens result. To relieve the symptoms, the patient must be gradually weaned of the habit.

Uses

Chloral is used principally:

1. To produce sleep.
2. To lessen the excitement of delirium tremens and other similar conditions.
3. To prevent the convulsions of strychnine poisoning, epilepsy, uraemia, etc.

Administration

Chloral hydrate is best given only slightly diluted in syrup, about 15 minutes to a half hour before bedtime.

Preparations

Chloral Hydrate (Chloralis Hydras, formerly Chloralum Hydratum)	0.6-2.0 Gms.	grs. x-xxx
Croton Chloral Hydrate or Butyl Chloral Hydrate	0.3-1.3 Gm.	grs. v-xx

This resembles chloral in its effects; it is not as efficient but the effects are more lasting and it relieves pain. It is frequently used to relieve the intense pain of trifacial neuralgia ("tic douloureux").

Amylene Chloral (Dormiol)	1.0-4.0 c.c.	m, xv- $\bar{z}$ i
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This is a colorless oily fluid with an odor like that of camphor. It is a compound of amylene hydrate and chloral. It produces sleep in about half an hour, with no after effects and it does not weaken the heart action. It is given principally to insane patients.

CHLORETONE

Chloretone is a white, crystalline powder which does not readily dissolve in water. It has an odor like camphor.

Local Action: Chloretone acts slightly as an antiseptic and is used in the nose as a soothing spray. It is also used as a dusting powder on ulcers.

Internal Action: It is absorbed from the stomach, from raw surfaces, and from mucous membranes. It produces sleep and lessens muscular contractions. Chloretone can produce general anaesthesia, but it is rarely used for this effect.

Chloretone is used to produce sleep, very frequently to check an epileptic attack; and to lessen other convulsions, such as those occurring in tetanus. It is occasionally used to check vomiting and seasickness.

Chloretone 0.3-1.0 Gm. grs. v-xv

It is used in a 1% solution.

SULFONAL AND TRIONAL

Sulfonal and trional resemble chloral in their effects, but they occur more slowly, however. They are slowly absorbed from the stomach in about one to six hours, producing sleep. In large doses they often make the breathing slow and shallow. They do not affect the heart action and do not relieve pain.

Poisonous Symptoms

The following symptoms may result from sulfonal:

1. Nausea, vomiting and diarrhoea.
2. Abdominal pain.
3. Stupor, mental confusion, hallucinations.
4. Suppression of urine, and the urine may contain albumin, casts and blood. In some cases the urine has a peculiar pink color, due to the formation of haematoporphyrine, a substance formed by the decomposition of haemoglobin.

Administration

Sulfonal or trional is best given in large quantities of hot milk or water, several hours before bedtime. When given in this way, they act more rapidly and are not so apt to cause unpleasant after effects. They may also be given in powder form.

Preparations

Sulfonal 0.8-2.0 Gms. grs. xii-xxx
(Sulphonmethanum)

This is a white powder without any odor or taste. Chemically, it is a compound of sulphur and alcohol. It does not dissolve readily in water.

Trional (Sulphonethylmethanum)	0.8-2.0 Gms.	grs. xii-xxx
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This is an artificial chemical substance. It is a powder with a bitter taste.

VERONAL or BARBITAL

Veronal, barbital, or diethyl barbituric acid, is a white crystalline powder, which has a slightly bitter taste. It is an artificial chemical substance.

Appearance of the Patient

About fifteen minutes to a half hour after an average dose of veronal is given, the patient usually falls asleep. The sleep resembles the normal sleep, and lasts for five to six hours. On awakening, the patient often complains of headache and dizziness. Occasionally, some patients have peculiar vivid dreams during the sleep. The pulse and breathing are not usually affected by veronal. It is a comparatively safe drug in small doses; but poisonous symptoms (prolonged sleep, coma, slow pulse and shallow breathing) have occasionally followed its indiscriminate use, especially in old people.

Administration

Veronal is usually given in hot milk, about fifteen minutes to a half hour before bedtime.

Preparations

Veronal or Barbital (Veronalum or Barbitalum)	0.3-1.0 Gm.	grs. v-xv
Diethyl Barbituric Acid		

It usually comes in tablets each containing 0.3 Gm. (grs. v) each. It also comes in the form of an elixir.

Veronal Sodium (Medinal) (Sodium Diethyl Barbiturate)	0.3 Gm.	grs. v
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This is a sodium salt of barbital. It usually comes in tablets each containing 0.3 Gm. (grs. v). It produces the same effects as veronal, but since it is more readily dissolved, it produces sleep more rapidly. It can be given hypodermically or by rectum.

Medinal Suppositories

Each suppository contains 0.5 Gm. (grs. vii $\frac{1}{2}$).

Barbital Compounds

Luminal or Phenobarbital (Phenyl Ethyl Barbituric Acid)	0.03–0.3 Gm.	grs. $\frac{1}{2}$ –v
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This acts like barbital but more rapidly and the sleep is deeper. It frequently causes a period of excitement before producing sleep. It lessens muscular twitchings. It is used as a hypnotic in insomnia, and extensively in epilepsy. It slows the respiration. It is given in doses of 0.5 Gm. (grs. viii). It also comes in the form of an elixir.

Luminal Sodium (Phenobarbital Sodium)	0.1–0.3 Gm.	grs. $i\frac{1}{2}$ –v
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This is more soluble than luminal. It comes in tablets of 0.03 Gm. (gr. $\frac{1}{2}$.) It also comes in the form of a 20% solution for hypodermic use.

Allonal	0.12–0.3 Gm.	grs. ii–v
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This is a compound consisting essentially of amidopyrine, and a barbital derivative. It is used as a sedative and hypnotic; for headaches, pain and insomnia. It comes in tablets.

Dial	0.06–0.3 Gm.	gr. i–v
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This is a compound of barbital.

BROMURAL

This is an organic bromide salt (monobrom-isovaleryl urea). It acts like barbital but is milder. It is used to produce sleep in nervous patients. The sleep usually lasts for three to five hours. It usually comes in tablets, each containing 0.3 Gm. (grs. v).

PARALDEHYDE

Paraldehyde is a colorless liquid having a peculiar, unpleasant taste and odor. It is an oxidation product of alcohol.

Paraldehyde has a hot, burning taste and often causes nausea and occasionally vomiting.

Paraldehyde is absorbed into the blood in a few minutes; through the mucous membrane of the stomach. After absorption, it acts principally on the nervous system, producing sleep. It resembles the natural sleep and lasts about five or six hours.

Excretion: Paraldehyde is excreted in the urine in a few hours. It is also eliminated by the expired air. The breath often has the unpleasant odor of paraldehyde for a long time after it is given. It may occasionally cause eruptions; areas of redness on the skin (erythema).

Poisonous Effects

Paraldehyde rarely, if ever, causes fatal symptoms. Overdoses often cause vomiting, stupor, slow, shallow breathing and cyanosis.

Uses

Paraldehyde is used principally to produce sleep and to lessen muscular activity in epilepsy and delirium tremens.

Administration

Paraldehyde has a very unpleasant taste which must be disguised. It should be well diluted in water, brandy, syrup, or sweetened butter. It should be given a few minutes before bedtime.

It is frequently given by the rectum especially in cases of delirium tremens. The best method is to dissolve the drug in boiled starch and then inject it into the rectum through a catheter.

Paraldehyde	1.0-4.0 Gms.	grs. xv- $\text{}\overline{3}\text{i}$
(Paraldehydum)		

URETHANE (ETHYL CARBAMATE)

Urethane or ethyl carbamate is a colorless, crystalline powder with a salty taste. It is an artificial chemical substance. Its effects are similar to those of paraldehyde, but it is not as reliable. It produces sleep in about 15 to 20 minutes, the sleep lasting for about 6 to 8 hours. It also increases the secretion of urine.

AMYLENE HYDRATE

Amylene hydrate is a colorless limpid liquid, having an odor resembling that of camphor, and a pungent taste.

It produces sleep, and its effects are similar to those of paraldehyde, but they are not as marked.

It is best given in capsules or in water, flavored with licorice.

Amylene Hydrate	2.0-4.0 c.c.	m. xxx- $\text{}\overline{3}\text{i}$
(Amyleni Hydras)		

HEDONAL

Hedonal is a white crystalline powder with a cooling effect in the mouth, like that of menthol.

It produces sleep in about half an hour after it is given. It is a comparatively safe drug and produces no after effects. It occasionally increases the flow of urine.

Hedonal	1.0-2.0 Gms.	grs. xv-xxx
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CHAPTER XXIV

ANALGESIC ANTIPYRETICS

Antipyretics are drugs which are used principally to lower the body temperature.

Heat Production and Elimination

The heat of the body is produced by the activity of the cells of the various organs of the body and by the contractions of the muscles.

When too much heat is produced, the excessive heat is eliminated in the following ways:

1. **By radiation from the skin.** The dilated blood vessels of the skin contain more overheated blood, and the excessive heat radiates from the skin.
2. **By increased perspiration.** The perspiration is overheated, and evaporation of the profuse sweat eliminates some of the heat.
3. **By the exhaled air.** The exhaled air contains more heat, which is eliminated by evaporation.

Heat Regulation

The heat of the body is kept at a constant temperature, usually about 98.6 Fahrenheit, by means of a regulating center of gray matter in the brain (situated in the region of the corpora quadrigemina). This is called the heat regulating center. It keeps the body temperature always at 98.6 F. in the following ways:

1. **When the temperature is below 98.6 F.,** it is brought up to normal again by increased production of heat. This is done by means of increased muscular activity and greater activity of the various organs of the body. For example, after a convulsion or a chill, which is a series of muscular contractions, the temperature usually rises several degrees.
2. **When the temperature is above 98.6 F.,** the temperature is lowered to normal again, by the increased elimination of heat. This is the result of increased sweating, dilatation of the blood vessels of the skin, and deeper and more rapid breathing. For example, when the weather is warm and the elimination of heat is retarded, the temperature is kept normal by profuse sweating, flushed skin, and deeper breathing.

When one is suddenly exposed to cold, and is therefore constantly losing heat, shivering occurs. Shivering is a series of fine muscular contractions or tremors, which produces enough heat to raise the body temperature to normal again.

The sensitiveness of the heat regulating center varies in different individuals. It can be tested by observing how low the temperature must be reduced in any individual, before shivering is produced, or how high the temperature must be raised, before sweating occurs.

Fever

The bacterial poisons, which cause most of the infectious diseases, usually affect the heat regulating center in such a way that it keeps the heat of the body regulated for a temperature higher than normal; perhaps 102 F. or 103 F., etc.

We then have, in these infectious diseases, the higher temperature of the body as one of the symptoms of the disease. A definite rise in temperature is usual for each infectious disease. If, however, the temperature rises still higher, the excessive heat is eliminated by sweating, flushed skin, etc., just as in the normal individual, until the temperature is lowered again to the usual range for that particular disease.

When the temperature is lower than the average for a specific disease, more heat is produced; by shivering, or by a chill, until the temperature is raised nearer to the usual range.

When the infection is overcome, the heat regulating center is again set for its normal point: 98.6 F.

Antipyretics

Drugs lower the temperature in three different ways.

1. By lessening the production of heat. This is accomplished by such drugs as quinine, morphine, which lessen muscular contractions and other activities of the body.

2. By increasing the elimination of heat. Drugs like pilocarpine or morphine which produce sweating, and drugs which widen the blood vessels of the skin, such as the nitrites, or the spirit of nitrous ether, aconite, etc., reduce the temperature in this way.

3. By setting the heat regulating center for a temperature nearer normal, so that the excessive heat is eliminated. The analgesic antipyretics act in this way. When the temperature is normal, these drugs produce no effect.

ANALGESIC ANTIPYRETICS

Coal Tar Antipyretics

The drugs belonging to the coal tar group were originally used to lower temperature. They are now principally used to relieve nervousness, headache and pain.

Source

The analgesic antipyretics are all made by chemical methods from coal tar. This is a thick tarry liquid which remains as a sediment, together with other substances, after coal has been distilled in the manufacture of illuminating gas.

The effects of these substances are due to **paramidophenol**, which they form in the body.

ANTIPYRINE, ACETANILID, PHENACETINE

Appearance of the Patient

About fifteen minutes to half an hour after an average dose of phenacetine or any of the coal tar substances is given, the patient

is relieved of neuralgic pains or headache and perspires profusely. If he has temperature, it may be reduced a few degrees or even to normal in several hours. The pulse and respiration are usually not very much affected. The skin is flushed and may be moist.

ACTION

Applied to the skin or mucous membranes: Antipyrine relieves pain and acts as an antiseptic. It checks bleeding by contracting the small blood vessels. Acetanilid is slightly irritating. Phenacetine has no local effects.

Internal Action

In the mouth the coal tar drugs have a bitter taste.

In the stomach and intestine there are no effects except nausea and vomiting which occur occasionally in fever patients.

Action after Absorption

The analgesic antipyretics are absorbed into the blood in about a half hour. Here a simpler chemical substance, **paramidophenol**, is formed from them which produces the effects of the drug.

After absorption they affect principally the brain, the temperature, the blood and the circulation.

Action on the brain: The analgesic antipyretics are soothing to the brain. They relieve neuralgic pains, nervous headache and irritability, making the patient calm and quiet. Acetanilid frequently produces light sleep.

Action on the temperature: The analgesic antipyretics lower the temperature several degrees or even to normal, in fever, by increasing the heat elimination and setting the heat regulating center for a lower temperature. It usually remains down for several hours. The normal temperature is not affected.

Action on the blood: Acetanilid and phenacetine form methaemoglobin in the blood, which does not combine with oxygen like ordinary haemoglobin. This causes the cyanosis that results from large doses.

Action on the circulation: The pulse is somewhat faster at first, but large doses make it slow and weak by lessening the force of the contractions of the heart muscle. When given together with caffeine, the tendency to cause a weak and slow pulse is increased.

Action on the respiration: The breathing is somewhat more rapid at first but it may become slower.

Action on the secretory glands: The secretion of sweat is increased.

Excretion

The analgesic antipyretics are slowly eliminated from the body in the urine, usually in about twelve to twenty-four hours.

Idiosyncrasies

In individuals, who are anaemic, or who have become weakened by prolonged illness, the following unusual symptoms occasionally occur:

1. Skin eruptions: redness and itching, often swelling of the face and eyelids, which may last for several days.
2. Nausea and vomiting.
3. Cyanosis (especially after acetanilid and phenacetine).
4. Dizziness.
5. Collapse.

Poisonous Symptoms

The symptoms of poisoning may appear suddenly, following a single overdose. Usually, however, they result from the continued use of patent headache powders.

Overdoses of analgesic antipyretics cause the following symptoms:

1. Nausea and vomiting.
2. Cyanosis (blue color of the face and hands).
3. Shortness of breath.
4. Slow weak pulse.

With larger doses, in addition to these symptoms, there may be the following:

5. Subnormal temperature.
6. Muscular twitchings.
7. Mental sluggishness, later stupor.
8. Collapse.

Treatment

Usually, stopping the drug is sufficient. In severe cases the following procedures are carried out:

1. Keep the patient quiet.
2. Wash out the stomach.

3. Give oxygen to relieve the cyanosis.
4. Atropine, strychnine and other stimulants are given.

Habit Formation

Many nervous patients get into the habit of taking various headache powders for the relief of nervousness and headache. The habit is most pernicious; not only because of the danger of poisonous symptoms developing, but because of the interference with the general health. The nurse should therefore discourage the use of these remedies; and only give them when other milder measures are of no avail. Continued use of the coal tar drugs causes the following symptoms:

1. Digestive disturbances.
2. Cyanosis and dyspnoea.
3. Rashes such as red blotches on the skin.
4. Nervousness, restlessness and sleeplessness.

The last two symptoms occur especially when the drugs are suddenly discontinued.

Uses of the Antipyretics

The antipyretics were originally used principally to reduce fever. Since most of them weaken the heart action, they are not used as much as they formerly were. Cold baths, cold sponges, etc., are preferable to reduce fever, as they do not affect the heart or blood.

The antipyretics are very useful drugs, however, and are now chiefly used to relieve indefinite pains and nervous headaches.

Better results are often obtained by combining small doses of several of these drugs, instead of giving an average dose of a single one.

Administration

The antipyretics are best given between meals in wine, whiskey, iced brandy, syrup, or milk. It was formerly customary to give these substances together with caffeine, but it has been shown that this increases the tendency to weaken the heart action. Sodium bicarbonate, however, tends to lessen the weakening action on the heart.

Antipyrine is occasionally given hypodermically. It should be injected deep into the muscles, to prevent the formation of abscesses.

Preparations

Antipyrine

Antipyrine is a white crystalline powder which is readily dissolved in water. It resembles an alkaloid in its chemical properties, combining with acids to form salts.

Antipyrine (Antipyrina)	0.3-1.3 Gms.	grs. x-xx
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Antipyrine Salicylate (Salipyrine) (Antipyrinae Salicylas)	0.3-2.0 Gms.	grs. v-xxx
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This is a combination of antipyrine with salicylic acid. It is said to relieve rheumatic pains more efficiently than either of its constituents alone.

Ferropyrine (Antipyrina cum Ferro)	0.3-1.0 Gm.	grs. v-xv
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This is a compound of antipyrine and iron chloride which is used to check bleeding.

Amidopyrine (Pyramidon) (Dimethylaminoantipyrina)	0.06-0.4 Gm.	grs. i-vi
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Pyramidon Acid Camphorate	0.6-1.0 Gm.	grs. x-xv
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Pyramidon Neutral Camphorate	0.5-0.8 Gm.	grs. viii-xii
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Melubrin	1.0-2.0 Gms.	grs. xv-xxx
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This is a complex organic substance which is used for rheumatism and sciatica.

Acetanilid (Antifebrine)

Acetanilid is a white crystalline powder formed by the action of glacial acetic acid, on anilin, a chemical substance which is an ingredient of many dyes. It is a neutral substance and does not form salts with acids. Chemically it is **phenylacetamid**. It is not readily dissolved in water.

Acetanilid (Acetanilidum)	0.06-0.6 Gm.	grs. i-x
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Compound Acetanilid Powder (Pulvis Acetanilidi Compositus)	0.5 Gm.	grs. viii
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This consists of 7 parts of acetanilid, 1 part of caffeine and 2 parts of sodium bicarbonate.

Acetphenetidin (Phenacetine)

Phenacetine, or acetphenetidin, is a white crystalline powder made from coal tar.

Phenacetine (Acetphenetidinum)	0.3-1.0 Gm.	grs. v-xv
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There are a large number of drugs made from coal tar, which are frequently used as antipyretics, but they are not official. Many of them are said to be safer than either antipyrine, acetanilid, or phenacetine.

Many patent headache powders contain coal tar antipyretics, and these frequently produce poisonous effects from continued use.

PART VII—DRUGS WHICH ACT UPON THE PERIPHERAL NERVE ENDINGS

CHAPTER XXV

STIMULANTS OF NERVE ENDINGS

Physiology of Nerve Endings

Many drugs principally affect the nerve endings. These are small microscopic structures that connect the terminations of the nerve fibers with the various tissues and organs of the body. The function of the nerve endings is to receive impulses for transmission to the spinal cord and brain when the nerve is a sensory or afferent nerve. When the nerve is a motor or secretory (efferent) nerve, its nerve endings transmit the impulses to the muscles or glands in which they are situated.

Stimulation of Nerve Endings

When the nerve endings are **stimulated**, the effects vary according to the function of the nerve; whether it is a sensory (afferent) nerve or a motor or secretory (efferent) nerve.

Stimulation of secretory nerve endings increases the secretion of the glands in which these nerve endings are situated, because the nerve endings then receive impulses for secretion more readily.

Stimulation of motor nerve endings increases the contractions of the muscles in which the nerve endings terminate, because impulses for contraction of these muscles are received more readily.

Stimulation of sensory nerve endings increases the appreciation of the sensations carried by these nerves; thus, an ordinary sensation of touch may be appreciated as a tingling sensation.

When the sensory nerve endings are stimulated, reflex action is increased, because impulses to the spinal cord are started more readily.

Depression of Nerve Endings

When the nerve endings are **depressed**, the following are the effects on the secretory, motor (efferent) and sensory (afferent) nerves:

Depression of secretory nerve endings lessens the secretion of the glands in which the nerve endings terminate, because impulses for secretion are not so readily received.

Depression of motor nerve endings lessens the contractions of the muscles in which the nerve endings terminate, because impulses for the contraction of these muscles are not as readily received.

Action of Autonomic Nerve Endings

When the autonomic nerve endings are stimulated, the effects vary according to whether the terminals of the vagotonic branches or the sympathetic branches are stimulated.

If the **vagotonic** branches are stimulated the following effects occur: contracted pupils, slow heart action, increased secretion and peristalsis of the gastro intestinal tract. Any or all of these effects will be produced, depending on which branches are stimulated.

If the **sympathetic** nerve endings are stimulated the following effects occur: a rapid heart action, diminished peristalsis and secretion of the gastro intestinal tract and dilated pupils. Uterine contractions are diminished.

When the autonomic nerve endings are depressed the opposite effect will be produced in each of the above instances.

We can therefore modify the function of many organs by means of drugs which act upon the nerve endings of branches of the autonomic nerves, see pages 256 and 261.

Depression of the sensory nerve endings lessens the appreciation of the various sensations. Numbness and insensibility to pain are produced when the sensory nerve endings of the skin are thus affected.

Since impulses are not able to be readily started when sensory nerve endings are depressed, substances which produce this effect also lessen reflex action.

The drugs that lessen the action of the **sensory** nerve endings are used principally as local anaesthetics.

SECRETORY STIMULANTS

Secretory stimulants are drugs whose principal action is to increase the secretions of the secretory glands. Practically, these substances are used only to increase the secretion of sweat.

Diaphoretics are drugs used principally to increase the secretion of sweat.

PILOCARPUS OR JABORANDI

Pilocarpus or jaborandi is obtained from the leaves of the *Pilocarpus jaborandi*, or *Pilocarpus microphyllus*, a Brazilian shrub. Its active principle is an alkaloid, **pilocarpine**. The preparations of pilocarpine, the alkaloid, are principally used. It has an odor resembling hay.

Appearance of the Patient

About five to fifteen minutes after a dose of pilocarpine is given, all the secretions are increased. The patient perspires profusely, there is a profuse flow of saliva, of tears, and of mucus from the nose, mouth and bronchi. The face is flushed, and the pupils are contracted. The breathing is faster, and the pulse is somewhat more rapid and weaker. The patient may complain of abdominal cramps and nausea and may have frequent bowel movements.

ACTION

Local action: Applied to the skin, pilocarpine produces no effects, but it is readily absorbed from such local applications.

It is believed to increase the growth of hair on the scalp, whether it is applied locally or given internally. The hair is usually lighter in color and grows in patches. **On mucous membranes:** It is readily absorbed, but does not affect them locally. For example, the application of a drop of pilocarpine solution in the eye causes only general or systemic effects.

Internal Action

In the mouth: Pilocarpine has a bitter taste.

In the stomach: It increases the secretion of gastric juice, and the peristalsis of the stomach. In large doses it often causes nausea and vomiting.

In the intestines: Pilocarpine increases the secretion of the mucous membrane and the peristaltic contractions of the muscle wall. Frequent movements of the bowels may result.

The effects on the stomach and intestines are due to stimulation of the nerve endings after the drug is absorbed and not to a local action in these organs.

Action after Absorption

Pilocarpine is very rapidly absorbed into the blood from the stomach, and from all the mucous membranes upon which it is applied; usually in about fifteen minutes. After absorption it affects principally the secretory glands, the involuntary muscles, the pupils, the heart and respiration.

Action on the secretory glands: This is the most important effect of pilocarpine. **It increases the secretions of all the secretory glands**, except those of the breasts, the liver, and the kidneys.

The secretion of the sweat glands is greatly increased (diaphoretic action). It is used principally to produce this effect. The great activity of the sweat glands makes the skin very red, and flushed, which may last for several hours.

Pilocarpine usually causes a profuse secretion of saliva, of tears, of mucus from the nose, and the bronchi. The secretion of the mucous membrane of the stomach and intestines is also increased. The secretion of milk, bile and urine, however, is not affected.

The effect on the secretory glands is the result of increased activity of the nerve endings for secretion in the various glands of the body. These nerve endings become more sensitive and receive impulses for secretion more readily.

Action on the involuntary muscles: In large doses pilocarpine

increases the contractions of all the involuntary muscles, by stimulating the nerve endings in these muscles.

The contractions of the involuntary muscles of the stomach and intestines (peristalsis) and of the involuntary muscles of the bronchi are all increased. The contractions of the involuntary muscles of the bladder often cause frequent urination accompanied by straining.

The spleen and uterus are also contracted by pilocarpine.

Action on the pupil: Pilocarpine contracts the pupil. The effect on the pupil is due to the increased contractions of the involuntary circular muscles of the iris of the eye, which makes the pupil smaller. The contractions of the ciliary muscle of the eye make the lens more convex, so that the patient sees only near objects, and has great difficulty in seeing distant ones. Pilocarpine also makes the eyeball softer, by causing a free circulation of fluid from the posterior to the anterior chamber of the eyeball. It is often used to produce this effect in glaucoma, a disease in which the eyeball becomes hardened and which often causes blindness.

Action on the circulation: In large doses pilocarpine makes the heart beat slower and weaker. The pulse is therefore slow and weak. It makes the Vagus nerve endings in the heart, more sensitive; so that they receive impulses to slow the heart more readily. The pulse may be somewhat stronger and faster for a few minutes. Poisonous doses dilate the small blood vessels.

Action on the respiration: The breathing becomes deeper and faster after large doses. This is due to the narrow bronchi which result from the contractions of their involuntary muscles, and the weakened heart action. The patient then has to breathe faster and deeper (asthmatic breathing) to get a sufficient amount of air in the lungs. Poisonous doses lessen the action of the respiratory center, thus making the breathing slow and shallow.

Effect on temperature: The profuse sweating which results from pilocarpine usually lowers the temperature slightly.

Excretion

Pilocarpine is excreted mainly in the urine and sweat. It begins to be eliminated in about an hour, and is entirely excreted in about twenty-four hours.

Dangers in the Use of Pilocarpine

Pilocarpine is a very efficient drug; but its use is limited by some of the following effects, which are often injurious to the patient.

1. The slow and weak pulse.

2. The profuse secretion of mucus in the bronchi fills up the lungs with mucus, and the contractions of their involuntary muscle makes the bronchial tubes narrower. The mucus is then expelled with difficulty, and the lungs fill up with fluid. This condition is known as **oedema of the lungs**. The patient is then said to "drown" in his own sweat.

3. Patients often feel very weak and chilly after pilocarpine.

Poisonous Effects

Since pilocarpine is rapidly excreted, only acute poisoning occurs, usually from an overdose.

Symptoms

1. Great weakness.
2. Profuse secretion of saliva.
3. Profuse perspiration and flow of tears.
4. Occasionally, nausea, vomiting, abdominal pain and profuse diarrhoea, with fluid stools.
5. Slow, irregular, weak pulse.
6. Rapid, difficult breathing, accompanied by "râles" (gurgling sounds in the lungs, due to the accumulation of mucus).
7. Contracted pupils.
8. Occasionally, dizziness, slight delirium, and twitchings of the muscles.

The breathing finally becomes slow and shallow, the patient complains of great weakness, and death may result.

Treatment

1. Atropine is given as an antidote. This paralyzes the nerve endings, and neutralizes the effects of pilocarpine.
2. Give artificial respiration if the breathing is slow and shallow.
3. Heart stimulants such as caffeine or camphor are usually given.

Uses

1. Pilocarpine is used principally to produce sweating; thus to eliminate retained waste products through the skin, and to remove fluid from the tissues (oedema) in cases of nephritis, when the patient secretes very little urine. Because of the excessive perspiration, the patient should be wrapped up in blankets and kept warm.

2. It is often given as a hair tonic, by local applications. The hair is the secretion of the hair follicle, and the effect is probably due to the increased secretion of this gland, as well as of the other secretory glands.

3. It is often given to overcome dizziness when it is due to lessened secretion in the labyrinth of the ear.

Preparations

Fluidextract of Pilocarpus (Fluidextractum Pilocarpi)	0.5–2.0 c.c.	m. viii–xxx
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Pilocarpine

Pilocarpine Hydrochloride (Pilocarpinae Hydrochloridum)	0.003–0.03 gm.	gr. $\frac{1}{20}$ – $\frac{1}{2}$
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Pilocarpine Nitrate (Pilocarpinae Nitras)	0.003–0.03 gm.	gr. $\frac{1}{20}$ – $\frac{1}{2}$
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MUSCARINE

Muscarine is an alkaloid, the poisonous principle of various poisonous mushrooms. It produces thirst, vomiting, diarrhoea, cramp like abdominal pains, suppression of urine and delirium. The symptoms resulting from eating poisonous mushrooms are similar to those of pilocarpine poisoning.

OTHER DIAPHORETICS

There are a number of drugs which increase the secretion of the secretory glands, especially the sweat glands, but they produce other more important effects. The most common ones are the following:

Ipecac (especially in the form of Dover's powder)

Apomorphine

Aconite

Veratrum Viride

Spiritus Aetheris Nitrosi (Sweet spirit of niter)

Salicylates

Coal tar preparations

and many of the saline diuretics, such as,

Potassium Citrate

Solution of Ammonium Acetate

STIMULANTS OF INVOLUNTARY MUSCLES

(Stimulants of the Motor Nerve Endings)

PHYSOSTIGMA AND ESERINE

Physostigma is obtained from the **Physostigma venenosum**, the calabar bean, or ordeal bean. It is a large bean, growing on a vine, principally in Calabar, on the western coast of Africa.

Its active principle is an alkaloid, **eserine**, or **physostigmine**.

A paste made from the calabar bean has been used for generations by the natives of the western coast of Africa, as a test in the trial by ordeal for various crimes, such as witchcraft. The accused individual was forced to eat the paste; if he died, he was guilty, otherwise he was considered innocent.

Appearance of the Patient

About fifteen minutes after giving a dose of eserine, the patient usually complains of cramp-like pains in the abdomen and slight weakness. He may feel somewhat nauseated, passes a good deal of flatus and the bowels move very freely, the stools being quite fluid.

The pulse may be slow and weak, and the breathing is at first somewhat rapid and deep, but later it becomes slow and shallow. The pupils are contracted, and the patient is unable to see distant objects clearly. He usually complains of weakness.

ACTION

The action of physostigma is due to the eserine which it contains. The alkaloid is the preparation commonly used. The effects of eserine are quite similar to those of pilocarpine. They are due to stimulation of nerve endings.

Internal Action

In the stomach and intestines: It markedly increases the peristalsis, producing cramp-like abdominal pains with the passage of flatus, and sometimes diarrhoea.

Action after Absorption

Eserine is very rapidly absorbed into the blood from the stomach, in about fifteen minutes to a half hour. After absorption it affects principally the involuntary muscles, the pupils, the secretory glands, the circulation and the respiration.

Action on the involuntary muscles: Eserine increases the contractions of all the involuntary muscles, by increasing the activity of the nerve endings in these muscles.

The muscles of the intestines are particularly affected, the peristalsis is very much increased, and frequent fluid movements of the bowels result. The contractions of the muscles of the ureter, bladder and uterus, are also increased.

Action on the pupils: Eserine contracts the pupil when used as eye drops, or when given internally. It makes the nerve

endings of the circular muscles of the iris more sensitive, so that impulses for their contractions are more readily received.

It also contracts the ciliary muscle of the eye, a muscle which holds the lens in place. The contraction of this muscle makes the lens more convex, so that the patient is unable to see distant objects clearly. It also causes a free circulation of fluid from the posterior to the anterior chamber of the eye, thereby making the eyeball softer. Eserine is often used to produce this effect in glaucoma, a disease in which the eyeball becomes hardened, and which often results in blindness.

Action on the secretory glands: Eserine increases the secretion of all the secretory glands, by making their nerve endings more sensitive to receive impulses for secretion.

The secretion of mucus from the nose and bronchi, tears, perspiration, and the digestive juices are all increased. The effect is not very marked, however, because of the contractions of the blood vessels in the glands. These contractions tend to neutralize the stimulation, by limiting the blood supply of the glands.

Action on the circulation: In large doses eserine makes the heart beat slightly slower and weaker.

Action on the respiration: After large doses the breathing is at first rapid and deep, because of the narrow bronchial tubes. Later, it becomes slow and shallow, as a result of lessened activity of the respiratory center in the medulla, so that fewer impulses for breathing are sent out.

Excretion

Eserine is very rapidly eliminated from the body in the urine and in all the secretions. It begins to be excreted in a few minutes, and is entirely eliminated in a few hours.

Poisonous Effects

Since eserine is very rapidly excreted, only acute poisoning occurs; usually from an overdose of the drug, given hypodermically or dropped into the conjunctiva of the eye.

Symptoms

1. Abdominal cramps, nausea and vomiting.
2. Diarrhoea, with frequent fluid stools.
3. Excessive flow of saliva and perspiration.
4. Rapid, then slow, shallow, difficult breathing.
5. Slow, irregular, weak pulse.

6. Contracted pupils.

7. Twitchings of the muscles, beginning in the legs and extending to the upper extremities, with great muscular weakness.

8. Collapse.

Treatment

1. The stomach should be washed out.

2. Keep the patient warm.

3. Give artificial respiration.

4. Atropine is given hypodermically. This is the antidote, as it paralyzes the overacting nerve endings, and increases the breathing.

5. The collapse is usually treated with heart stimulants.

Uses

Eserine is principally used in the following conditions:

1. To soften the eyeball in glaucoma, and to contract the pupil.

2. To increase the peristalsis, to cause frequent movements of the bowels, and to expel gas. It is frequently used for the latter effect, on patients that have just been operated upon, and who have difficulty in passing gas; especially after gynecological operations. It should be avoided when the operation has been performed upon the stomach or intestines.

3. It is occasionally used in chronic constipation.

Preparations

Physostigma

Extract of Physostigma
(Extractum Physostigmatis)

0.008-0.06 Gm.

gr. $\frac{1}{8}$ -i

Tincture of Physostigma
(Tinctura Physostigmatis)

1.0-3.0 c.c

m. xv-xlv

Eserine

Eserine Salicylate
(Physostigminae Salicylas)

0.001-0.003 Gm.

gr. $\frac{1}{80}$ - $\frac{1}{20}$

Eserine Sulphate
(Physostigminae Sulphas)

0.001-0.003 Gm.

gr. $\frac{1}{80}$ - $\frac{1}{20}$

CHAPTER XXVI

DEPRESSANTS OF SECRETORY AND MOTOR NERVE ENDINGS

SECRETORY DEPRESSANTS

BELLADONNA GROUP

The belladonna group consists of a number of drugs producing more or less similar effects. They are all obtained from plants belonging to the botanical family, known as the Solanaceae. The active principles of the members of this group are the alkaloids, **atropine**, **hyoscyamine** and **hyoscyne**. These alkaloids are closely related to one another, both in composition and in effects. Atropine, for instance, is a compound of two forms of hyoscyne. Homatropine is an alkaloid formed by decomposing atropine and combining it with oxytoluic acid. Other artificial alkaloids may be formed in a similar manner.

The members of the belladonna group are the following plants:

Atropa Belladonna (Deadly Nightshade), which contains atropine with small quantities of hyoscyne and hyoscyamine.

Hyoscyamus Niger, containing hyoscyamine, hyoscyne, and small quantities of atropine.

Datura Stramonium (Thorn apple) which contains atropine, hyoscyamine, and small quantities of hyoscyne.

Other less important drugs which contain atropine are:

Duboisia Myoporoides

Scopola Atropoides

Mandragora Autumnalis

Atropa Mandragora (Mandrake)

BELLADONNA AND ATROPINE

Belladonna is a drug obtained from the leaves and roots of the **Atropa belladonna** or **Deadly nightshade**. It is a perennial plant, about three feet high, which ordinarily grows in England and other parts of Europe, but it has also been cultivated in this country. Its active principles are the following alkaloids:

Atropine**Hyoscyamine****Hyoscine**

The effects of belladonna are due principally to the atropine which it contains. This is preferred for internal use.

Appearance of the Patient

After administration of atropine, or one of the atropine containing drugs, such as belladonna or hyoscyamus, the following effects result within ten minutes to a half hour:

The patient looks brighter, the face and neck are somewhat flushed, and the pupils are dilated. He is more wakeful and more alert. The pulse is rapid and strong and the breathing is deeper and faster. Various cramp-like pains, such as pains in the stomach, intestines, or bladder, are relieved.

The patient is thirsty, complains of dryness of the mouth and throat. The skin usually feels dry, and may be quite flushed.

If the patient has an attack of shortness of breath, this is usually relieved.

ACTION

Local action: On the skin, atropine relieves pain, and checks the secretion of sweat. This effect is produced by paralyzing the sensory nerve endings in the skin. It is often used for this purpose in the form of a belladonna plaster. Atropine or belladonna is readily absorbed from the skin, if applied in a solution of alcohol, glycerin, oil, or camphor, or in the form of a plaster. It often causes general, even poisonous, symptoms from such applications. **On mucous membranes:** It checks the secretion.

Internal Action

In the mouth: Atropine has a bitter, burning taste, and checks the secretion of saliva and mucus. It makes the mouth and throat feel dry. If this effect is marked, the patient is unable to swallow.

In the stomach: It lessens the secretion of gastric juice and the peristalsis of the stomach.

In the intestines: Atropine checks the secretion of the mucous membrane of the intestines and lessens the peristaltic contractions of its muscle wall. It is often used for this purpose to check the griping pains of cathartics.

Action after Absorption

Atropine enters the blood through the mucous membrane of the stomach and intestines. It is rapidly absorbed, usually within a half to one hour. It can also be absorbed from other mucous membranes. After absorption it affects principally the heart, the respiration, the brain, all the secretory glands, the involuntary muscles and the pupils.

Action on the heart: Atropine makes the heart beat faster and stronger. This effect is due to the paralysis of the nerve endings in the heart, of the Vagus or inhibitory nerves. The checking or slowing influence is then taken away from the heart, so that impulses for slowing the heart will not reach it. As a result, the accelerator nerves have full play, and the only impulses that reach the heart make it beat stronger and faster.

Action on the blood vessels: The blood vessels of the skin are widened. This causes the flushing of the face and neck, often noticed after administration of atropine. The small arteries of the abdomen, however, are constricted by the contractions of their muscle fibers, as a result of impulses which reach them from the vaso constrictor center in the medulla of the brain. It slightly increases the blood pressure.

Action on the respiration: Atropine makes the breathing faster and deeper by increasing the impulses for breathing that are constantly being sent from the respiratory center of the medulla.

Action on the nervous system: In ordinary doses there is very little effect on the brain. With large doses the patient becomes talkative and wakeful and may go on to a talkative delirium, with poisonous doses. This is followed by symptoms of lessened brain activity (depression), because the brain then becomes exhausted from overactivity.

Action on the secretory glands: Atropine lessens the secretion of all the secretory glands, by paralyzing the nerve endings of the secretory nerves in the various glands.

Effect on Secretions

<i>Gland</i>	<i>Secretion</i>	<i>Effect</i>
Digestive glands	Saliva	Diminished; excessive thirst
	Gastric juice	Diminished
	Intestinal secretions	Diminished
	Pancreatic juice	Only water lessened. Secretion of its digestive ferments are not due to nervous influences, but to chemical substances formed in the stomach (secretin)
	Bile	Lessens change of glycogen to sugar
Sweat glands	Perspiration	Diminished
Breasts	Milk	Diminished
Mucous glands	Mucus	Diminished
Kidneys	Urine	No effect

Action on the involuntary muscles: Atropine lessens the contractions of all the involuntary muscles, by paralyzing the nerve endings of the nerves which carry impulses to these muscles. Thus, the peristalsis of the stomach and intestines, the contractions of the bladder, of the uterus, and of the bronchial muscles are all lessened by atropine.

Action on the pupil: Atropine dilates the pupil by paralyzing the nerve endings of the nerves in the circular muscle fibers of the iris, or colored part of the eye. The radial muscles then have free play, and their contractions widen the pupil. The pupil may remain dilated for days.

Patients are often unable to see near objects clearly after atropine has been dropped into the eye. This is due to the effect on the nerve endings of the ciliary muscle, a muscle which changes the contour of the lens for near and distant objects (accommodation). The relaxation of this muscle prevents the lens from changing its contour for near objects, which cannot then be seen.

Effect on the temperature: In large doses atropine often causes a rise of temperature.

Excretion

Atropine, or a drug containing atropine, is excreted mainly in the urine. It is eliminated in about ten to twenty hours. Part of the drug is oxidized and used up in the body.

Idiosyncrasies

The following unusual effects occasionally occur:

1. Ordinary doses of atropine sometimes cause delirium.
2. When applied to the conjunctiva of the eye, atropine often causes inflammation of the eyelids and face.
3. The rash caused by atropine may spread all over the body, and the skin may peel (desquamate). It may be mistaken for scarlet fever.
4. Children can stand comparatively large doses of atropine.

Poisonous Effects

Acute atropine poisoning usually results from excessive doses of atropine or drugs containing atropine. Dangerous symptoms have resulted from gr. $\frac{1}{20}$ — $\frac{1}{10}$ and death has occurred in about six hours after it was taken.

Since atropine is rapidly excreted, cumulative symptoms, or chronic atropine poisoning does not occur.

Symptoms

In giving atropine or atropine containing drugs the nurse should watch for **excessive thirst** and **talkativeness**. She should report these symptoms to the physician as soon as they occur.

The earliest and most characteristic symptoms of atropine poisoning are the following:

1. **Dryness of the mouth and throat.**
2. Excessive thirst.
3. Difficulty in swallowing.
4. Hoarseness.
5. **Flushed, dry skin**, especially of the face and neck.
6. **Very rapid pulse and breathing.**
7. **The pupils are widely dilated** and near objects cannot be seen distinctly.

If *very large doses* of atropine are taken, these symptoms are increased and may be followed by the following:

The patient is talkative and confused. He may begin a sentence and not finish it. He is light headed, and bursts into fits of laughter and tears. Occasionally he has illusions or hallucina-

tions of sight. He talks continuously to objects or persons he seems to see about him. He may become quarrelsome and have to be restrained. Tremors of the muscles and convulsions finally develop.

Frequently the excessive excitement is followed by stupor, coma and collapse. The breathing becomes slow and shallow, cyanosis develops and death results from paralysis of the respiration.

Although atropine is a respiratory stimulant, the nurse should remember that from poisonous doses the respiratory center becomes depressed and may finally be entirely paralyzed and death ensue.

Treatment

1. Wash out the stomach, or give emetics.
2. Give tannic acid or old tea to combine with the atropine to neutralize it.
3. Catheterize the patient, to avoid reabsorption of the atropine from the urine in the bladder, especially since patients suffering from atropine poisoning may not pass much urine.
5. Keep the body warm; give mustard baths.
6. Give artificial respiration if the breathing is embarrassed.
7. Stimulants, such as caffeine, strychnine, are usually given.
8. **Do not give morphine;** for, while atropine is the antidote for morphine, the dangerous effects of atropine are due to the exhaustion of the breathing. If morphine is given in such cases, the breathing is only made slower. Morphine is not therefore an antidote for atropine, though atropine is an antidote for morphine. Chloroform should also be avoided.

Uses

The following are the most important uses of atropine or belladonna:

1. In the form of a belladonna plaster or liniment, atropine or belladonna is used to relieve pain, on the site where it is applied.
2. As a cardiac and respiratory stimulant, especially when immediate effects are desired.
3. As an antidote for morphine poisoning. It is very often given together with morphine to avoid poisonous effects.
4. Atropine is often given to check secretions, for example, to check profuse sweating, or the secretion of milk.
5. To lessen cramp-like pains produced by contractions of involuntary muscles. **It is often prescribed together with purgatives to lessen their griping.**

6. It relieves the colic which is produced by the contractions of the involuntary muscles of the bile ducts, when gall stones attempt to pass along these ducts. It also relieves the colic of the ureters of the kidney (renal colic) resulting from the passage of a stone or other substance along the ureter. It frequently relieves painful urination produced by the spasmodic contractions of the involuntary muscles at the neck of the bladder.

7. It often relieves the pains of an ulcer in the stomach by lessening the contractions of the involuntary muscles of the stomach.

8. Atropine is very often used to relieve bronchial asthma. It is particularly valuable in this condition, because it lessens the spasms of the involuntary muscles of the bronchi, and at the same time it checks the secretion of its mucous membranes.

9. Atropine is very often used to dilate the pupil, so that the retina or background of the eye may be more easily examined. It is also used to prevent adhesions between the iris and lens when the iris is inflamed.

10. It is very often used in diabetes in large doses. It is believed to lessen the amount of sugar in the urine.

Preparations

Preparations Made from the Leaves

For Internal Use

Extract of Belladonna (Extractum Belladonnae)	0.005-0.03 Gm.	gr. $\frac{1}{12}$ - $\frac{1}{2}$
Tincture of Belladonna (Tinctura Belladonnae)	0.3-1.0 c.c.	m. v-xv

For Local Use

Belladonna Ointment
(Unguentum Belladonnae)

This contains about 10% of the extract of belladonna.

Belladonna Plaster
(Emplastrum Belladonnae)

This contains 3 parts of the extract of belladonna and 7 parts of adhesive plaster.

Preparations Made from Belladonna Root

For Internal Use

Fluidextract of Belladonna Root (Fluidextractum Belladonnae Radicis)	0.06-0.12 c.c.	m. i-ii
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For Local Use

Belladonna Liniment
(Linimentum Belladonnae)

This consists of the fluid extract to which has been added about 5% of camphor.

Preparations of Atropine

For Internal Use

Atropine (Atropina)	0.0004–0.001 Gm.	gr. $\frac{1}{160}$ – $\frac{1}{60}$
Atropine Sulphate (Atropinae Sulphas)	0.0004–0.001 Gm.	gr. $\frac{1}{160}$ – $\frac{1}{60}$

For hypodermic use, atropine often comes in tablets, each containing the required dose, or in $\frac{1}{2}$ to 1% solutions.

For Local Use

Oleate of Atropine (Oleatum Atropinae)

This contains about 2% of atropine.

Atropine Ointment (Unguentum Atropinae)

This contains about 4% of atropine.

Homatropine

Homatropine is an artificial alkaloid of atropine. It is formed by a combination of tropine, an alkaloid obtained by decomposing atropine, with oxytoluic acid, or mandelic acid.

The effects of homatropine are similar to those of atropine. It dilates the pupil more rapidly than atropine, but the effect is not as lasting. Its local use in the eye, for instance, is not so apt to cause general symptoms as easily as atropine.

Homatropine is used principally to dilate the pupil, by dropping a solution of the drug into the conjunctiva of the eye.

Homatropine Hydrobromide (Homatropinae Hydrobromidum)	0.0006–0.001 Gm.	gr. $\frac{1}{100}$ – $\frac{1}{60}$
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This is used principally in $\frac{1}{2}$ to 1% solutions for local applications to the eye.

Euphthalmine or Eucatropine

This is an artificial alkaloid which is used in 2% solutions to dilate the pupils. It does not affect the circulation.

STRAMONIUM

Stramonium, Thornapple, or Jamestown Weed is obtained from the leaves of the *Datura stramonium*, a weed growing in England and the United States. Its active principles consist mostly of **hyoscine** but it also contains **atropine** and **hyoscyamine**.

Action: Stramonium is usually given to relieve an attack of spasmodic asthma.

The breathing becomes easier, and the pulse is strong and rapid. The patient complains of dryness of the mouth and throat, is very thirsty and the pupils are dilated.

Administration: Stramonium is given in the form of cigarettes, which are smoked during an attack of asthma, or the leaves are burned in a saucer and the smoke inhaled. It relieves the attack by relaxing the spasm of the involuntary muscles of the bronchi.

Preparations

Stramonium leaves made up into cigarettes, or the plain dried leaves, are the most commonly used preparations.

Tincture of Stramonium	0.3-1.0 c.c.	m. v-xv
(Tinctura Stramonii)		

Stramonium Ointment
(Unguentum Stramonii)

This contains 10% of the extract of stramonium. It is used principally for painful haemorrhoids.

HYOSCYAMUS

Hyoscyamus is obtained from the leaves and flowering tops of *Hyoscyamus niger* or *henbane*, when the plant is two years old. It grows best in England, but it has been successfully cultivated in the United States. It contains mostly *hyoscyamine*, also *hyoscyne* and small quantities of *atropine*.

The effects of hyoscyamus are quite similar to those of belladonna and atropine, except that they are much weaker.

Preparations

Tincture of Hyoscyamus	1.0-4.0 c.c.	m. xv-3i
(Tinctura Hyoscyami)		
Hyoscyamine Sulphate	0.0005-0.001 Gm.	gr. $\frac{1}{120} - \frac{1}{60}$
(Hyoscyaminae Sulphas)		
Hyoscyamine Hydrobromide	0.0005-0.001 Gm.	gr. $\frac{1}{120} - \frac{1}{60}$
(Hyoscyaminae Hydrobromidum)		

HYOSCINE OR SCOPOLAMINE

Appearance of the Patient

About half to one hour after the administration of hyoscyne, the patient feels tired and drowsy. He becomes less active, less talkative and soon falls asleep. The sleep resembles the normal sleep, and lasts from about five to eight hours, though the patient may feel drowsy for some time after that. The pulse and breathing are slow, and the pupils are dilated. When the patient awakes, he usually complains of dryness of the throat and mouth, and is very thirsty. If the patient is delirious he becomes quiet.

Hyoscine produces sleep more easily if the room is darkened and free from loud noises.

ACTION

The action of hyoscine resembles that of atropine with the following differences:

1. **Action on the pupil:** It dilates the pupil more rapidly than atropine, but the effects last for only a short time.

2. **Action on the heart:** It makes the heart beat slower. The pulse is therefore slower after hyoscine.

3. **Action on the respiration:** Hyoscine does not increase the breathing as much as atropine does.

4. **Action on the brain:** The activity of the brain is lessened by hyoscine. It produces sleep, lessens muscular twitchings and quiets delirium. It lessens especially the memory of various sensations. A patient may not remember having seen certain objects or having had pain.

Occasionally, there is a short period of excitement before the patient falls asleep. He may feel dizzy and be quite active, though the movements are unsteady, and the speech becomes difficult and indistinct.

Poisonous doses produce collapse: rapid, weak thready pulse, pallor, dilated pupils and cold perspiration.

Uses

Hyoscine is usually given hypodermically, to produce sleep; and as a sedative, especially in cases of delirium, mania, delirium tremens, etc.

Scopolamine Morphine Anaesthesia

(Twilight Sleep)

Hyoscine or scopolamine is given together with morphine to produce a state of mild unconsciousness or anaesthesia, so as to enable the performance of painless operations. It may be used alone or as a preliminary to a general anaesthetic.

It has frequently been used, however, for painless childbirth. The method, which is commonly known as "twilight sleep," consists in inducing the following effects:

1. A drowsy state in which the consciousness, as well as the sense of pain, is lessened.

2. A loss of memory for pain.

Method of Administration: The desired condition is brought about by giving a dose of hyoscine with morphine as soon as labor pains start. The hyoscine alone is then repeated every hour; but each time in a smaller dose.

The effect of the drug is enhanced by darkening the room and maintaining calm and quiet surroundings.

To determine whether the desired effects are obtained, the nurse should test the patient's memory about every half hour throughout the administration: by showing the patient the same object at frequent intervals. When the patient does not remember the object seen, the desired effect is obtained. The same object should not be shown too often, however, as the test may then become unreliable. During treatment, the patient should be carefully watched for symptoms of collapse and poisoning (atropine poisoning). Many patients are delirious throughout the treatment, although they do not remember the pains.

Preparations

Hyoscine Hydrobromide (<i>Hyoscinae Hydrobromidum</i>)	0.0003-0.0006 Gm.	gr. $\frac{1}{200}$ - $\frac{1}{100}$
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Scopolamine Hydrobromide (<i>Scopolaminae Hydrobromidum</i>)		
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This is the same as hyoscine hydrobromide.

Euscopole	0.0003 Gm.	gr. $\frac{1}{200}$
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This has a milder action than scopolamine.

SCOPOLA

Scopola is obtained from the underground stems of the *Scopola atropoides*, a plant which grows on the hills of central and southern Europe. It acts like atropine but is less effective.

Preparations

Extract of Scopola (<i>Extractum Scopolae</i>)	0.015-0.03 gm.	gr. $\frac{1}{4}$ - $\frac{1}{2}$
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Fluidextract of Scopola (<i>Fluidextractum Scopolae</i>)	0.06-0.12 c.c.	m. i-ii
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OTHER SECRETORY DEPRESSANTS

AGARICUS AND AGARICIN

Agaricus is a fungus, the white agaric, or *Agaricus albus* or *Polyposis laricis*. Agaric acid, or agaricin, is the preparation principally used.

Agaricin checks the secretion of sweat, by paralyzing the nerve endings in the sweat glands which cause secretion. The effect, however, is not as marked as that of atropine. Secretions of the other secretory glands are not affected. It often causes nausea and frequent movements of the bowels. It does not affect the heart, respiration or pupils. It is used principally to check the night sweats of tuberculosis. It should be given about 4 or 5 hours before the expected sweat.

Preparations

Agaricin	0.005-0.06 Gm.	gr. $\frac{1}{12}$ - i
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This is best given in pill form about five or six hours before retiring, as it is very slowly absorbed.

Agaric Acid (<i>Acidum Agaricum</i>)	0.015-0.03 Gm.	grs. $\frac{1}{4}$ - $\frac{1}{2}$
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This is a very poisonous substance. Overdoses cause vomiting, diarrhoea and collapse.

CAMPHORIC ACID

Camphoric acid is a white crystalline powder, formed by the action of nitric acid on camphor. It is used to check excessive perspiration.

Camphoric Acid (Acidum Camphoricum)	1.0-2.0 Gms.	grs. xv-xxx
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MOTOR DEPRESSANTS

PAPAVERINE

Papaverine is one of the alkaloids obtained from opium. It acts like morphine only to a very slight degree. It relieves pain and lessens the activity of the brain only slightly but it is somewhat of a local anaesthetic.

It lessens the contractions of all involuntary muscles such as those of the stomach, the ureters, gall ducts, and intestines.

It is therefore used to lessen the pains caused by the spasm of the involuntary muscles, in ulcer of the stomach, gall stone colic, kidney colic, painful menstruation and painful urination. It is also used to lower blood pressure and to lessen the convulsions in eclampsia. Papavarine does not induce a habit.

Preparations

Papaverine (Papaverinae)	0.03-0.08 Gm.	gr. $\frac{1}{2}$ - $i\frac{1}{3}$
Papaverine Hydrochloride (Papaverinae hydrochloridum)	0.03-0.08 Gm.	gr. $\frac{1}{2}$ - $i\frac{1}{3}$

This also comes in tablets each containing 0.04 Gm.

Papaverine sulphate (Papaverinae sulphas)	0.03-0.08 Gm.	gr. $\frac{1}{2}$ - $i\frac{1}{3}$
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BENZYL BENZOATE

Benzyl benzoate is a colorless oily liquid formed by the combination of benzyl alcohol with benzoic acid. (Such a compound, formed by the combination of an alcohol with an organic acid, is called an ester.) Benzyl benzoate may be obtained by the distillation of balsam of Peru or the balsam of Tolu. It is also present in various other balsams and in the volatile oils of various flowers such as gardenias, jasmine, tuberose, hyacinth and orange blossoms.

Action

Benzyl benzoate acts principally on the involuntary muscles, like papaverine, but it is much more efficient. It relieves the

spasm of all involuntary muscles such as those of the intestines, the gall bladder, the ureters, the bronchi and the blood vessels.

It is used principally to check the pains due to spasm in gall stone colic, kidney colic, to relieve painful menstruation and abdominal cramps. It is also used to check diarrhoea in chronic dysentery and mucous colitis and to lower blood pressure.

Administration

Benzyl benzoate has a very unpleasant taste. It should therefore be given in a thick syrup. It is usually prescribed in the form of a thick mixture with mucilage of acacia and flavored with a syrup or an elixir, such as the elixir of lactopeptone or the elixir of eriodictyon.

Preparations

Benzyl benzoate	0.6-2.0 c.c.	m. x-xxx
(Benzyl benzoas)		

This is a 20% alcoholic solution of benzyl benzoate.

Benzyl Succinate	0.3-1.0 Gm.	grs. v-xv
(Benzylis Succinas)		

This is tasteless and more pleasant to take.

OTHER MOTOR DEPRESSANTS

The following group of drugs act in about the same manner. They all paralyze the nerve endings of the muscles, principally the involuntary muscles. They are not often used in medicine at the present time since they are very poisonous, producing the following symptoms:

1. Nausea, vomiting, and diarrhoea.
2. Profuse flow of saliva.
3. Languid, tired, drowsy feeling.
4. Slow, shallow breathing.
5. Slow, weak pulse.

SPARTEINE

Sparteine is a fluid alkaloid which is obtained from *Scoparius* or broom tops. When given by mouth it acts principally upon the heart, making it beat slower and weaker by weakening the contractions of the heart muscle, causing a slow weak pulse. It was formerly considered to be a heart stimulant, but its use for this purpose has been given up since it has been shown to have a directly opposite effect. Sparteine does not increase the flow of urine, as does *scoparius*, the crude drug from which it is obtained.

Sparteine Sulphate	0.04-0.12 Gm.	grs. $\frac{1}{15}$ - ii
(Sparteinae Sulphas)		

GELSEMIUM

This is obtained from the roots and underground stems of *Gelsemium sempervirens*, yellow jasmine or Carolina jasmine, a climbing plant of the southern United States. Its active principle is an alkaloid, gelseminine.

It lessens muscular twitchings and is used occasionally to lessen the painful contractions of the muscles of the face in trigeminal neuralgia or "tic douloureux." It is given in the form of a tincture in doses of 0.06-0.3 c.c. (m. i-v).

LOBELIA

Lobelia is obtained from the leaves and tops of the **Lobelia Inflata**, or Indian Tobacco, an American plant. It is occasionally used to lessen the spasmodic contractions in bronchial asthma. It is given in the form of a tincture, 0.6-4.0 c.c. (m. x-5i).

TOBACCO

Tobacco is the dried and pressed leaf of **Nicotiana Tabacum**, or the tobacco plant. It contains nicotine, a very poisonous volatile fluid alkaloid, as well as a number of other substances.

Tobacco is not used as a medicine but is extensively used by many people, smoked as cigars and cigarettes, or chewed, or taken as snuff.

Tobacco lessens the contractions of the involuntary muscles of the bronchi. A strong cigar will often relieve an attack of asthma. It increases the peristalsis and will often act as an excellent cathartic.

In persons who do not smoke habitually, smoking will often cause excessive flow of saliva, excessive perspiration, nausea and vomiting, headache, drowsiness, weakness and a slow pulse. In those who smoke habitually it does not produce such effects.

Nicotine is one of the most violent poisons known. It causes a slow weak pulse, nausea, vomiting and often diarrhoea.

Chronic tobacco poisoning is a frequent condition which follows excessive smoking. The symptoms are due principally to the nicotine. The patient usually complains of palpitation of the heart, has a rapid, irregular pulse, is very nervous and may have digestive disturbances.

CONIUM

Conium is obtained from the fruits and flowers of the **Conium maculatum**, or poison hemlock, a European plant. Conium is not used in medicine but it has become famous because it was the poison given to Socrates, the famous Greek philosopher, when he was condemned to death. It was used at that time as a means to kill criminals in Athens.

The poisonous symptoms consist principally of weakness and heaviness of the lower extremities, with staggering, and the patient is unable to walk. This is followed by intense general weakness all over the body, so that the patient cannot move any of his muscles. The pulse becomes slow, the skin is moist, and death finally results in a short time from arrested breathing.

CURARA

Curara, Woorara, Woorali or Urari, is an arrow poison which is used by the South American Indians. It is made from the bark of various trees such as the **Strychnos Toxifera**. Its active principle is an alkaloid, curarine. It is rarely used in practical medicine, but it is frequently used in animal experiments to paralyze the nerve endings in the muscles, thereby lessening their contractions.

CHAPTER XXVII

LOCAL ANAESTHETICS

(Depressants of the Sensory Nerve Endings)

Local anaesthetics are drugs which produce insensibility to pain in the tissues to which they are applied or into which they are injected.

The most commonly used substances for this purpose are cocaine, procaine or novocaine, and their derivatives.

Some of the local anaesthetics are applied directly to the surface of the skin or mucous membranes, while others are injected underneath the skin (hypodermically).

COCAINE

Coca is obtained from the dried leaves of the **Erythroxylon coca**, a shrub growing in Peru, Bolivia and other South American countries. It is now also cultivated in India, Java and Ceylon. The coca leaves are extensively used by the natives of South America. They chew it to lessen fatigue and hunger. The active principle of coca is the alkaloid **cocaine**.

Cocaine is easily decomposed and various artificial alkaloids are made from it.

Appearance of the Patient

A hypodermic injection of an average dose of cocaine, or its application to the mucous membranes, usually produces insensibility to pain in the area where it is injected or on the mucous membrane to which it is applied. As soon as the cocaine is absorbed, usually in ten or fifteen minutes, if the dose has been large, the patient becomes restless, somewhat more active, and more talkative. He often complains of headache and dryness of the throat and may feel happy and joyful. The pulse is rapid, strong and small, the breathing is rapid and deep, and the pupils are dilated.

ACTION

Local action: Applied to the skin, cocaine produces no effects, but if it is injected under the skin, or applied to a wound or

ulcer surface, it relieves pain at the site of injection or application. If it is injected into a nerve, it lessens pain in the area of skin or mucous membrane from which the nerve fibers come.

On mucous membranes: Cocaine relieves pain, makes the membrane very pale and reduces swelling. It also checks bleeding by contracting the blood vessels.

The insensibility to pain, or anaesthesia, produced by cocaine, lasts only for a short time: for about fifteen minutes to a half hour, depending on the strength of the solution used.

The mucous membrane of the eye, nose, pharynx, larynx, oesophagus, stomach, urethra, bladder, vagina and rectum, are all affected by local applications of cocaine and it is absorbed from all of them. **In the nose**, in addition to the effects on the mucous membrane, it lessens the sense of smell, by paralyzing the nerve endings which receive impressions of smell.

Internal Action

In the mouth: Cocaine has a bitter taste for a short time, as it soon paralyzes the nerve endings in the tongue which appreciate bitter substances. It also lessens pain on the mucous membrane of the mouth, and contracts its blood vessels.

In the stomach: It often lessens vomiting and hiccough, by paralyzing the nerve endings in the stomach, so that impulses which cause vomiting or hiccough are checked.

Action after Absorption

Cocaine is very rapidly absorbed into the blood from all mucous membranes, and from any region of the body where it may be injected; usually in about ten or fifteen minutes. After absorption it affects principally the circulation, the respiration, the brain and the pupil.

Action on the circulation: **On the heart:** Cocaine makes the heart beat stronger and faster. It contracts the blood vessels and raises the blood pressure.

Action on the respiration: Cocaine makes the breathing faster and deeper.

Action on the brain: In large doses it increases the activity of every part of the brain. The patient is wakeful, talkative, walks about, and may be somewhat excited. These effects are due to the increased activity of the motor and speech areas of the brain. The patient also becomes somewhat joyful and happy.

Overdoses cause, at first, greatly increased activity of the brain, and then, from exhaustion, very much lessened activity (see poisonous effects).

Action on the pupils: It rapidly dilates the pupil, usually in about a half to one hour. It does not affect the sight for near and distant objects (accommodation). The effect wears off in about twenty-four hours.

Excretion

Cocaine is partly excreted in the urine, but most of it is destroyed in the body.

Poisonous Effects

Cocaine poisoning occurs in two forms: **acute cocaine poisoning**, and **cocaine habit**, or **chronic cocaine poisoning**.

Acute Cocaine Poisoning

Acute cocaine poisoning results from overdoses of cocaine injected hypodermically, or from its application to the mucous membranes for local anaesthesia. The symptoms vary somewhat in different individuals. Some individuals are so susceptible to the drug that small doses may cause poisonous effects.

Symptoms

1. Usually the patient becomes **quite talkative, happy and jolly**, though he may be somewhat confused in his speech and ideas. He is quite anxious about his condition.

2. He is quite **active and moves about a great deal**.

3. **The pulse is very rapid and small, and the breathing is very rapid.**

4. The skin is pale, and covered with sweat.

5. The pupils are widely dilated.

6. Occasionally there may be vomiting.

7. Soon the **delirium** becomes more marked, the patient may seem to see objects about him, he may have muscular contractions of the hands and feet. These are soon followed by either **clonic or tonic convulsions**, more often clonic. Occasionally the patient may be maniacal.

8. Finally the convulsions increase, coma and collapse develop and death ensues.

9. At times there may be no convulsions and no excitement, **but sudden collapse and death.**

Treatment

1. Reassure the patient that his condition is not serious.
2. Apply an icebag to the head.
3. The collapse is treated with stimulants, such as *caffeine*, *strychnine*, *camphor*, *nitroglycerine*, etc.

Cocaine Habit

The cocaine habit is unfortunately very common, and is often induced by its beneficial effects in the nose for the relief of hay fever, catarrh, etc. It is usually taken in a liquid or powder form. The powder is usually snuffed up into the nose. Many of the cocaine habitués are also addicted to the use of other habit-forming drugs, such as morphine.

Besides the gradual disturbance in the general health, the cocaine habitué develops symptoms:

1. When not under the influence of the drug.
2. After he has received his usual dose.

When not under the effects of the drug, the individual feels depressed and is usually nervous, irritable and has twitching of the hands and arms. He is restless and cannot concentrate his mind on anything, and is unable to do his work.

When he has taken his usual dose, the habitué usually brightens up, feels stronger and more energetic. The former symptoms disappear, and the pupils become dilated.

After continued use, however, a weakened condition of both body and mind develops. The habitué becomes thin, emaciated and anaemic. He suffers from various digestive disturbances, a loss of appetite, foul breath, a drooling of saliva from the mouth, and constipation. He is usually unable to sleep.

Finally, however, the mental and moral faculties become undermined and he eventually becomes a burden to himself, his family and friends, and an economic loss to society. He has no will power, no self-control, and does not want to work. He is careless of his person and of his actions. He forgets his responsibilities, neglects his family and develops all sorts of base moral tendencies. He usually has various nervous symptoms; such as twitching of the muscles and peculiar sensations on the skin. Many habitués frequently develop hallucinations and a peculiar jumping delirium, and others become insane.

The condition is best treated in special sanitariums; and the method consists of withdrawing the drug gradually.

Uses

Cocaine is the best drug for local anaesthesia. It is readily absorbed into the blood, however, and may then cause poisonous symptoms. To avoid these symptoms, it should be remembered that the total amount of any solution of cocaine or its derivatives to be injected should not contain more than 0.03 Gm. (gr. $\frac{1}{2}$) of cocaine hydrochloride, which is its maximum dose.

As a local anaesthetic, cocaine is given in the following ways:

1. On mucous membranes, such as the nose, throat or larynx, it is applied with a cotton applicator. A 10 or 20% solution is used for this purpose.

Occasionally a few drops of a solution of cocaine powder dissolved in epinephrine or adrenalin, are used. Such a solution contracts the blood vessels very markedly, prevents the absorption of the cocaine and at the same time produces a maximum anaesthetic effect.

2. **Infiltration anaesthesia.** This is a method of injecting cocaine in very weak solutions, such as a 1-1000 to $\frac{1}{2}$ % solution. For large areas, large quantities of weaker solutions may be used. For small areas, stronger solutions such as 4%, may be used. To avoid poisonous effects, the cocaine is often injected together with epinephrine or adrenalin solutions. There are a number of preparations made up in this way.

The absorption of cocaine is often prevented by tying a tight bandage around the part to be anaesthetized, so as to contract its blood vessels.

3. Cocaine is also occasionally injected into the nerve leading from the part to be operated upon. This lessens the sensibility of the area from which the nerve fibers come.

Cocaine is sometimes used to relieve colds in the nose (acute coryza), and to check vomiting and hiccough.

Preparations

Coca

Wine of Coca (Vinum Cocae)	4.0-16.0 c.c.	3i-3 $\frac{1}{2}$
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Cocaine

Cocaine (Cocaina)	0.008-0.03 Gm.	gr. $\frac{1}{8}$ - $\frac{1}{2}$
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This is seldom used because it does not dissolve readily in water. It does dissolve in oils.

Cocaine Hydrochloride (Cocainae Hydrochloridum)	0.008-0.03 Gm.	gr. $\frac{1}{8}$ - $\frac{1}{2}$
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For local applications, watery solutions are used in strengths varying from $\frac{1}{2}\%$ to 10% For nose and throat work 20% solutions are often used. The powdered cocaine dissolved in epinephrine solution is sometimes used.

The following solutions are used principally for infiltration anaesthesia:
Kraun's Solution

This consists of cocaine hydrochloride, 0.05–0.1 Gm., and epinephrine chloride solution, 0.3–0.6, c. c. in 100 c. c. normal salt solution.

Schleich's Solution

This is made by dissolving 3 tablets, each of which contains: cocaine hydrochloride, 0.03 Gm.; morphine hydrochloride, 0.008 Gm., and sodium chloride, 0.06 Gm., in 100 c.c. of water.

Artificial Alkaloids

Novocaine or Procaine

Novocaine or Procaine is an artificial alkaloid which is used as a local anaesthetic. It acts like cocaine, but it is less poisonous and its effects wear off quickly. It is usually given together with epinephrine. It is not of much value when applied on mucous membranes. The effects are only produced when it is injected hypodermically, but they are not lasting. The dissolved tablet is injected in 50 or 100 c.c. of normal salt solution. It is usually given with 0.3–0.6 c.c. of epinephrine

Preparations

Novocaine or Procaine Tablets Each tablet contains 0.02–0.2 Gm. (gr. $\frac{1}{3}$ –iii).

There are also tablets containing novocaine and adrenalin.

Novocaine Nitrate or Procaine Nitrate 0.02–0.2 Gm. gr. $\frac{1}{3}$ –iii
(Novocainae Nitras)

This is principally used in a 3% solution.

Saligenin or Salicaine
(Saligeninum)

This is salicyl alcohol. It acts like procaine but is not as poisonous. It is used in stronger solutions.

Chlorbutanol

This is a strong local anaesthetic.

Alypine

Alypine is an artificial alkaloid which is used as a local anaesthetic. It is said not to produce poisonous symptoms. It is used principally as a local anaesthetic for eye operations; and in the urethra and bladder, before passing instruments into these organs. In the eye it is used in 1–2% solutions. On other mucous membranes, it is used in 1–10% solutions.

Alypine Tablets Each tablet contains 0.02–0.2 Gm. (grs. $\frac{1}{8}$ – iii).

Eucaine or Beta Eucaine

Eucaine is an artificial alkaloid which is used as a local anaesthetic. It produces local anaesthesia, like cocaine. It differs from cocaine, however, in the following ways:

1. It is irritating and does not contract the blood vessels.
2. It slows and weakens the contractions of the heart, by directly affecting the heart muscle, thereby causing a slow weak pulse, with low blood pressure.

3. It does not dilate the pupil.

For local anaesthesia in the eye, it is used in a $\frac{1}{2}\%$ solution. On other mucous membranes, it is applied in 2-10% solutions.

For infiltration anaesthesia, it is used in a 1-500 to 1% solution.

Eucaine is not as poisonous as cocaine, and can be boiled.

It is also often used in the form of an ointment for painful haemorrhoids.

Beta Eucaine Hydrochloride

(Beta Eucainae Hydrochloridum)

Beta Eucaine Lactate

(Beta Eucainae Lactas)

This is more soluble than the hydrochloride salt.

Tropacocaine

Tropacocaine is an alkaloid obtained from the leaves of the coca plant of Java, but it is usually made artificially.

It is used principally to produce local anaesthesia. Its effects are similar to those of cocaine, but they appear sooner, and last longer. It does not dilate the pupil as much as cocaine, but it is irritating.

Tropacocaine Hydrochloride 0.03-0.06 Gm. gr. $\frac{1}{2}$ -i

(Tropacocainae Hydrochloridum)

This is used principally in 3-10% solutions which can be boiled.

Holocain

Holocain is an artificial alkaloid made from phenacetine. Its effects are similar to those of cocaine, but they appear sooner. It does not dilate the pupil. It is also an antiseptic. Occasionally it causes poisonous symptoms.

Holocain Hydrochloride or Phenacaine Hydrochloride

(Holocainae Hydrochloridum)

It is principally used in a 1% solution, as a local anaesthetic in the eye. The action is more rapid than that of cocaine.

Stovaine

Stovaine is an artificial alkaloid which is used principally as a local anaesthetic and for spinal anaesthesia. Its effects are similar to those of cocaine with the following differences:

1. It dilates the blood vessels.
2. It is less poisonous than cocaine.

Stovaine

This comes in tablets each containing 0.002 Gm. (gr. $\frac{1}{30}$).

In the eye it is used in a 4% solution. On other mucous membranes, in a 5-10% solution. Hypodermically, it is used in a $\frac{1}{3}$ -1% solution.

Butyn

This is a complex chemical substance which acts like cocaine but it is not as poisonous in the strengths used. It is used as a local application in the eye, nose and throat in 1 to 5% solutions.

BENZYL ALCOHOL

This is an aromatic alcohol which is made chemically. It is used in a 25% solution with physiological salt solution by hypodermic injection or direct application to mucous membranes, as a local anaesthetic especially in the genito urinary tract. It is not poisonous.

SPINAL ANAESTHESIA

Anaesthesia is often produced by injecting a solution of one of the local anaesthetics into the spinal canal. The solution is very slowly injected by means of a hypodermic syringe with a specially constructed needle which is inserted into the spinal canal between two of the vertebrae. This produces anaesthesia in about 15 to 20 minutes over the entire surface of the body below the level of the point of injection. The effect is due to the action of the drug on the nerve trunks which enter the spinal cord.

The drugs principally used for this purpose are cocaine, tropacocaine, and stovaine. Dangerous symptoms and even death may result from this method of anaesthesia.

LOCAL ANAESTHETICS USED BY DIRECT APPLICATION

ETHYL CHLORIDE

Ethyl chloride is commonly used as a local anaesthetic. It is usually sprayed on the skin, by means of a special glass container. It freezes the area over which it is sprayed by its very rapid evaporation, thereby producing local anaesthesia. The spraying should be stopped when the skin becomes white and hard, as it may injure the tissues if continued further.

MENTHOL

Menthol is a camphor-like substance (stearoptene) obtained from the oil of peppermint. It makes the skin and mucous membranes feel cool, and produces local anaesthesia. The anaesthesia is not sufficiently marked, however, to enable a surgical operation to be performed. It is used principally to relieve painful conditions of the skin.

ORTHOFORM

Orthoform is an artificial chemical substance formed by the combination of methyl alcohol and amidoxybenzoic acid (such a combination of an alcohol and an acid is called an ester).

It is used as a local anaesthetic like cocaine, but since it is very slowly absorbed, it produces no general effects and no poisonous symptoms. It is not used hypodermically. The principal use of orthoform is to relieve pain on a wounded surface and on mucous membranes. It is often used to relieve the pain of an ulcer in the stomach.

It is often applied on wounds in the form of a dusting powder or as an ointment.

It is applied locally in the larynx to lessen coughing and in the vagina and rectum to lessen itching.

Orthoform New 0.5–1.0 Gm. grs. viii–xv

ANAESTHESIN

Anaesthesin is a chemical substance used as a local anaesthetic. It is an ester of alcohol and paramidobenzoic acid.

The effects of anaesthesin are similar to those of cocaine. Local anaesthesia, but no general effects are produced, as it does not dissolve readily and is not absorbed.

It is given by mouth to relieve the pain of ulcers in the stomach or of cancer of the stomach. It is also applied to relieve pain on the mucous membrane of the nose, throat, urethra, etc., and on wounded surfaces and ulcers, in the form of a powder or ointment.

Anaesthesin 0.3–0.5 Gm. grs. v–viii

Cycloform 0.1–0.2 Gm. grs. i½–iii

This produces the same effects as anaesthesin, but is somewhat antiseptic.

Propaesin 0.25–0.5 Gm. grs. iv–viii

This acts like anaesthesin and it also contracts the mucous membrane. It is often used in 1–20% ointments.

MAGNESIUM SULPHATE

Magnesium sulphate or Epsom salt is used principally as a purgative. Applied locally, however, it has a slight anaesthetic effect. When injected into the spinal canal it produces anaesthesia. The patient loses consciousness and the muscles become relaxed.

Uses: Magnesium sulphate is applied locally in saturated solutions to inflammations of the skin and other skin diseases. It is also applied locally in solutions of a similar strength for rheumatic swellings of the joints, neuritis, etc. It relieves the pain by its local anaesthetic effect and the swelling by withdrawing fluid from the tissues.

PART VIII.—SUBSTANCES WHICH IMPROVE NUTRITION

CHAPTER XXVIII

MEDICINAL FOODS

The substances used principally to improve nutrition may be divided into the following three groups:

Medicinal Foods

Mineral Substances

Alteratives

Medicinal foods are preparations consisting of various food principles.

Mineral salts are used to supply the deficiency of various salts in the body.

Alteratives are drugs which improve the nutrition of the body, or of various organs of the body. Their mode of action is unknown. They are old-fashioned remedies and are said to improve the condition of the blood.

MEDICINAL FOODS

Medicinal foods are preparations containing easily digestible food principles in concentrated form with or without added medicinal substances. Some of the foods are predigested. They are used principally in wasting diseases to improve the general health and strength of the body and to build up the tissues in conditions where the digestion is impaired. They are also used in diseases of metabolism where the patient is unable to assimilate specific kinds of foods.

The medicinal foods may be classified according to the essential food principles which they contain and according to the conditions for which they are principally used. The food principles contained in most foods are protein, fat, carbohydrate, salts, water and vitamins.

Most of the preparations of the medicinal foods commonly used consist of these food principles in various proportions.

In some preparations they are dissolved in alcohol or glycerin, which merely act as preservatives.

All the medicinal foods improve the health and strength by helping to build up the tissues. They are often given together with various tonics such as iron, arsenic, phosphorus, etc. Some medicinal foods contain a minimum amount of the food principles which cannot be assimilated in certain diseases. Others contain substitutes. For example, the different flours and foods used in diabetes, belong to these groups.

CARBOHYDRATE PREPARATIONS

Carbohydrate foods contain large quantities of various carbohydrates. They are often prepared by the action of starch-digesting ferments on starch or by other means by which the starch is changed to dextrin or glucose.

GLUCOSE, DEXTROSE OR STARCH SUGAR

Glucose, anhydrous glucose or dextrose is a sugar which is prepared by the action of dilute acids on starch. This is the sugar which is present in the blood. The percentage of sugar in the blood is kept constant. It is usually about 0.08 to 0.12%. In certain diseases, such as diabetes, the percentage of sugar in the blood is increased.

Action: Glucose solutions have the same effect on the circulation as normal salt solution, but they provide energy as well. If the percentage of sugar in the blood is increased, fluid is absorbed into the blood to lower it, and if this percentage is lowered, fluid is eliminated through the kidneys to raise the percentage.

When given by mouth, glucose is digested by the saliva and pancreatic juice. It is then absorbed into the blood and helps to provide energy.

When given intravenously in concentrated solutions, it acts as a diuretic, increasing the flow of urine. Such concentrated solutions increase the sugar content of the blood. Consequently, fluid is absorbed into the blood until the percentage reaches the normal again. The excess of fluid is then eliminated by the kidneys, thus increasing the flow of urine.

Uses

Glucose is used as a food in cases of malnutrition in doses of about 180.0 Gms. (3 vi) daily.

It is used in shock together with acacia.

It is also used to increase the flow of urine and to relieve oedema.

It is given in acidosis, when insulin is administered, to prevent a hypoglycaemic reaction.

It is given intravenously in a 10 to 15% solution in about 250 to 300 c.c. quantities or by rectum in 5 to 12% solutions.

LEVULOSE OR FRUIT SUGAR (DIABETIN)

Levulose is a sugar which is used to sweeten the food for diabetic patients who cannot take ordinary sugars.

GLUSIDE OR SACCHARIN (BENZOLSULPHINIDUM)

Gluside or saccharin is a chemical substance which has a very sweet taste. It is 200 times sweeter than sugar and is used to sweeten foods for diabetic patients. It is given in doses of 0.03 Gm. (gr. $\frac{1}{2}$) together with sodium bicarbonate 0.3 Gm. (grs. v), since it dissolves better in alkaline solutions.

Saxin is a preparation of saccharin.

MALT

Malt is barley grain which has been made to grow artificially and the growth stopped by heat. During this process of growth, the starch contained in the barley is changed to sugar by means of diastase, a ferment which is present in the barley grain. Malt is given to help the digestion of starchy foods because it contains this diastase. Many malt preparations contain no diastase and produce no digestive effects, though they are easily digested foods and are readily assimilated in wasting diseases. Some malt extracts contain alcohol and are therefore similar to beer or stout. Malt preparations are given as foods to children and nursing mothers.

Preparations

Extract of Malt (Extractum Malti)	16.0 Gms.	℥ss
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This contains maltose, a sugar found in malt, 48-70%, dextrin 2 to 16%, protein, 3 to 5%, a small amount of phosphate, and diastase. The maltose is said to be more readily assimilated than other forms of sugar.

Maltine

This is a preparation made from malted barley, oats and wheat. It also comes with cascara sagrada, with cod liver oil, and with creosote.

Ovaltine

This is a concentrated medicinal food used in convalescence, tuberculosis, malnutrition, tuberculosis, etc. It contains protein 14%, fat 8%, carbohydrates 67%, phosphorous 1.18% and diastase. One or two teaspoonfuls are given in a cup of water.

Preparations Used for Infant Feeding

Borcherdt's Malt Sugar

This is a mixture containing 87.4% of maltose, 4.35% of dextrin and 4.4% of protein. It is used instead of lactose in milk mixtures, for feeding infants. 30.0 Gms. (℥i) is added to 600 c. c. (℥xx) of milk.

Dextri Maltose No. 1

This contains maltose 52%, and dextrin 41.7%, and sodium chloride 2%. There are two similar preparations: No. 2, which contains no sodium chloride, and No. 3, which contains potassium bicarbonate 2%. They are used to supplement the carbohydrates of cow's milk. The potassium counteracts the tendency to constipation and is therefore adapted to feeding constipated infants.

Keller's Malt Soup

This is a soup made by boiling or heating a special malt preparation and wheat flour with milk in varying proportions according to the age of the child. It is used principally for infant feeding. The following malt preparations are used in preparing this food:

Borcherdt's Dry Malt Soup Extract

This contains 71% maltose, 13% dextrin, 8.7% protein, salts 2.9%.

Borcherdt's Dry Malt Soup Extract with Wheat Flour

This is a powder containing 100 Gms. of malt soup extract and 50 Gms. of wheat flour.

Mead's Dry Malt Soup Stock

This is a mixture containing desiccated maltose 23.5%, desiccated dextrin 23.5%, wheat flour 47%, potassium carbonate 1%.

PROTEIN PREPARATIONS

The protein foods are used in conjunction with soups, gruels, and other liquid foods. They are often predigested and are very useful in cases where the digestion is poor and the stomach cannot stand ordinary protein food. In a predigested form they are also given in nutrient enemata.

MEAT JUICES

There are two kinds of meat juices, **Cold meat juices** and **Warm meat juices**.

Cold Meat Juice: This is made by chopping up lean meat from the round of beef, into fine pieces, and expressing their juice. It contains about 6% of the meat protein and is very nutritious.

Warm Meat Juice: This is made by chopping up lean meat from the round of beef, expressing the pieces, and allowing them to remain in water in a warm place for about half an hour.

The commercial meat juices consist of meat powder, salts and blood which are dissolved in glycerin or alcohol. They aid the appetite and stimulate the secretion of gastric juice.

MEAT EXTRACTS

The meat extracts contain very little proteins, gelatine 16%, and 22% inorganic salts, and are not very nourishing. They contain mostly extractives which make the patient feel better and increase the appetite. The most common beef extracts used are extracts made by various firms, beef teas and beef essences.

GELATINE

Gelatine is an albumin like (albuminoid) substance derived from fibrous and cartilaginous tissue. It becomes solid when cool, and liquid when heated. It is an easily digested food.

It also helps to coagulate the blood, and is frequently used to check bleeding from the nose, the intestines, the kidney, etc. It may be applied locally to the bleeding area or it is given internally.

Gelatine is frequently given hypodermically or in normal salt solution by means of a hypodermoclysis. The solution must be absolutely sterile, as tetanus occasionally results from unsterile gelatine, which may contain tetanus bacilli.

Internally, it is given in doses of $\mathfrak{z}$ i-ii, three or four times a day, or in the form of a jelly, flavored, to taste better.

Preparations

Gelatine (Gelatinum)	4.0-8.0 c.c.	$\mathfrak{z}$ i-ii
Glycerinated Gelatine (Gelatinum Glycerinatum)		

This is gelatine impregnated with an equal amount of glycerin.

LIQUID PEPTONOIDS

Liquid peptonoids contains about 5% of proteins, and about 10% of carbohydrates, mainly in the form of sugars. It is given in doses of 15.0-30.0 c. c. ($\mathfrak{z}$ $\frac{1}{2}$ -i).

DRY PROTEIN PREPARATIONS

Dry protein preparations are used to increase the percentage of protein in various foods such as gruels, soups, etc.

DRY PEPTONOIDS

Dry peptonoids is made by digesting beef, milk and wheat. It contains 40% protein and 50% carbohydrate. The proteins of these foods are digested by pancreatin, and the carbohydrates, by malt diastase. It is given in 8.0-16.0 c.c. $\mathfrak{z}$ ii- $\mathfrak{z}$ $\frac{1}{2}$ doses in water, milk, wine, broths, soup and gruels.

CASEIN

This is an easily digestible protein obtained from milk by the action of ferments or acids.

CALCIUM CASEINATE

This is a combination of casein, a protein obtained from milk, with calcium. It contains 1 to 2% of calcium. It is more readily dissolved than the casein itself. It is used principally in diarrhoea, in infants. It is given to adults in convalescence and when they are undernourished.

It is given in a mixture of milk and water, or in milk and gruel. It is prepared by adding 10 Gms. to a 50 c.c. solution and boiling. When given to adults, it is mixed with milk, skimmed milk, or buttermilk in doses of 20.0 Gms. to 1,000 c.c.

Casec, Larosan Roche and Protolac: These are various preparations of calcium caseinate.

MODIFIED MILKS

Modified milks are milk foods which have been predigested or modified by the growth of harmless organisms in them or by a change in their composition.

PEPTONIZED MILK

Peptonized milk is milk which has been partially or completely digested by pancreatic extract. When the milk is partially digested, the proteins of the milk are changed to peptones, which are more assimilable forms of proteins. When it is completely digested, the proteins are changed to still simpler substances. Peptonized milk is useful in conditions where the patient cannot digest food, in malnutrition or in prolonged illnesses. Other foods may be digested in a similar way.

Peptonized foods are prepared by the use of a peptonizing powder, **Pulvis Pancreaticus Compositus**. This is a powder which contains 0.3 Gm. (gr. v) of pancreatic extract and 1.0 Gm. (grs. xv) of sodium bicarbonate.

Method of Peptonizing Milk

Partially peptonized milk: To a bottle containing 500 c.c. (1 pt.) of milk and 120 c.c. (½ iv) of water, add one peptonizing powder. Keep the bottle at a temperature of 105–115° F. This may be done by placing it in hot water at that temperature for about 20 minutes to a half hour. Partially peptonized milk has a slightly bitter taste.

Completely peptonized milk: This is prepared in the same manner but it is kept at a temperature of 105–115° F. for two hours. It has a very bitter taste.

Peptonized milk gruels, peptonized beef tea, peptonized oysters, peptonized milk toast, etc., are prepared in the same way.

MODIFIED MILKS USED PRINCIPALLY FOR INFANT FEEDING

Dry Protein Milk, Powdered Protein Milk or Albumin Milk, Hoos

This is a modified milk preparation containing protein 30%, butterfat 25%, and lactose 15%. It is used for intestinal disturbances of infants and children. It is prepared by sprinkling 3 ounces of the preparation in a quart of warm boiled water, and then beating the mixture with an egg beater. The curds should be broken up with a spoon and the fluid strained through a fine strainer. Carbohydrate foods may be added to this liquid.

Dryco

This is powdered dried milk from which some of the fat has been removed. It contains protein, 32%, butter fat 12%, milk sugar 46% and salts 7%. It is used principally for feeding infants. About one or two ounces of the powder are made into a paste with boiling water, which is then dissolved in the necessary amount of boiling water.

Beebe Protein Milk (Finkelstein's Eiweiss Milch)

This is a modified milk preparation containing approximately protein (casein) 5.3%, fat 1.6%, carbonates 2.5%, and mineral salts 0.8%.

The large percentage of protein in this preparation is believed to prevent fermentation in the intestines and the relative absence of mineral salts and lactose, lessens irritation. It is used in gastro-intestinal disorders of infants, to check fermentation and diarrhoea, and when they cannot digest sugar and fat.

It is given in small quantities according to the age and condition of the patient, after the patient has been starved for a day or two. Carbohydrate foods may also be added.

It is prepared by pouring through a strainer into a quart can, forcing the solid part through with a spoon. Starchy foods dissolved in water may be added. The finished mixture contains approximately 31.7% of protein, 15.1% of carbohydrates and 9.5% of fat, without the added carbohydrates.

Beebe Modified Buttermilk or Buttermilk with Flour (Langstein and Meyers' Buttermilk)

This is a preparation of buttermilk containing flour partially changed to dextrin by heating. It contains approximately carbohydrates 4.7%, proteins 3.3%, fat 0.6% and mineral salts 1.2%. The carbohydrates are of several kinds, each having a different rate of digestion. It is therefore used when digestion and assimilation is slow. It is used especially in digestive disturbances of children and adults, characterized by vomiting, and when milk cannot be borne.

About 175–300 c.c. are given at each feeding.

FERMENTED MILKS

Fermented milks are preparations of milk which have been soured either naturally or artificially by adding various harmless bacteria to it. These organisms grow in the milk, forming lactic acid in it, which gives the sour taste. The bacteria used for this purpose are the *Bacillus bulgaricus* and the *Streptococcus lactis*. Some preparations of soured milk are made by adding various yeasts such as *Kefir* and *Kumyss* in addition to the bacteria. Sour milk prepared in this way has been used for centuries in the Balkan States as a food by the peasants. Many of these peasants have lived to a ripe old age, and their diet, consisting principally of soured milk, is believed to be the cause of this. Metchnikoff, a prominent bacteriologist, emphasized this fact and propounded the idea that premature old age and hardening of the arteries may be due to chronic putrefaction (decomposition) of waste products occurring in the large intestine as the result of the growth of various bacteria. The growth of *Bacillus bulgaricus* or other lactic acid forming bacteria in the intestines checks putrefaction.

The *Bacillus acidophilus* is another organism normally found in the intestinal tract, which also checks putrefaction. This organism is present in large numbers in the intestinal tract of breast-fed infants, where putrefaction occurs to a very slight extent. Milk soured with the *Bacillus acidophilus* or cultures of the *Bacillus acidophilus* has been used extensively to check putrefaction in the intestines. When these bacteria are made to grow in large numbers in the intestinal tract, the growth of putrefactive bacteria is checked. Since the *Bacillus acidophilus* grows best in the presence of lactose or milk sugar, the preparations given also contain lactose.

Uses

Sour milk and its preparations are used in acute diarrhoea, in chronic infections of the intestinal tract, and in malnutrition. In many gastro-intestinal diseases, fermented milks are more readily digested and are better assimilated than the ordinary milk containing the same percentages of fat, sugar and protein.

The fermented milks are given in the form of buttermilk, or as milk fermented with the *Bacillus bulgaricus* or with the *Bacillus acidophilus*, or in the form of a liquid containing a growth of these bacteria, or as a dried culture of them. The liquid cultures are sometimes applied locally to stimulate healing.

Preparations

Milk Preparations

Kumyss or Koumiss

This is a fermented milk prepared from mare's milk by the Tartars who originated it. It is made from cow's milk in this country by fermenting milk with yeast. Liquid yeast is added to the milk and the resulting fluid is then allowed to stand for about eight to ten hours in a lukewarm place and then cooled.

Kefir Kumyss or Matzoon

This is made by fermenting milk with Kefir fungus, which is a mixture of bacteria and yeasts obtained from Caucasasia in Russia. This ferment produces lactic acid and ferments the milk. It is on the market under various names such as Zoolak, etc. It is prepared from fresh cow's milk by adding the fungus and then allowing the mixture to stand at a temperature of 21-27° C. When the fermentation is complete the grains rise to the top and are strained off. The milk is then placed in bottles and corked. There is enough yeast left in the milk to continue the fermentation. During the fermentation the fat, salt and water are unchanged. The percentage of lactose is diminished. Lactic acid, small amounts of alcohol and carbon dioxide are formed and the casein is partially digested.

Yoghurt

This is a fermented milk which comes in a soft jelly-like form.

Bacillus Acidophilus Milk

This is whole milk to which a culture of *Bacillus acidophilus* has been added. When finished it contains about fifty million bacilli in every c.c. It is given in 500-1000 c.c. doses.

Liquid Cultures

Bacillus Bulgaricus Culture

1-4 vials

This is a broth culture of *Bacillus bulgaricus*. It comes in vials, each containing from 5.0-7.0 c.c., or in bottles containing about 90 c.c. It is given in sweetened water or milk before retiring.

Lactampoule

Each vial contains 12 c.c. of a culture of *Bacillus bulgaricus*.

Lactenzyme Bouillon

This comes in vials each containing 6 c.c. of *Bacillus bulgaricus* bouillon.

Vitalait Starter

This is a culture of *Bacillus bulgaricus* which comes in ampoules, one ampoule is added to 1 to 3 quarts of milk to produce fermentation.

Solid Preparations

Bulgarian Bacillus Tablets

This is a dried culture of the *Bacillus bulgaricus* which comes in tablets. The dose is 1 to 2 tablets after meals, and in infants, 1 to 2 tablets at each feeding.

Bulgara Tablets

Galactenzyme Tablets

Lactic Bacillary Tablets

These are pure cultures of *Bacillus bulgaricus* in tablet form.

Cultol

This is a jelly-like substance which consists of a culture of *Bacillus acidophilus*, mineral oil and petroleum jelly. It is given in doses of 4.0 c.c. (3i) for constipation and to check intestinal putrefaction.

DIABETIC FOODS

Diabetes is a disease in which the patient is unable to burn up carbohydrates, with the result that the percentage of sugar in the blood is increased and the patient excretes sugar in the urine. The treatment of diabetes by diet, consists in limiting the quantity of carbohydrates taken in the food. The diabetic diet is so arranged that minimum amounts of carbohydrates are taken and the necessary calories for nutrition are replaced by proteins and fats. Such foods can usually be obtained in a very large variety from the usual foods.

Diabetic patients frequently miss carbohydrates or starches in their diet, and it is often essential to obtain substitutes. There are therefore, a number of food preparations which are used as substitutes for the eliminated carbohydrates. Certain other foods are used to give bulk to the diet, since the limited diet of the diabetic may be insufficient in quantity and the patient suffers from the lack of bulk.

Most of the preparations of diabetic substitute foods consist wholly of proteins. The nurse should remember, however, that about 58% of the proteins of the food is changed to sugar in the body. Consequently, when such substitutes are given, the patient is not getting a carbohydrate free food, but a food from which 58% of the proteins will form carbohydrates; but this is much less than the carbohydrates contained in an unmodified diet.

The diabetic substitute foods are used principally in the preparation of cakes, bread, desserts, etc.

Preparations

Gluten Foods

Gluten Foods, A, B, and C

These are flours which are made from the gluten of wheat, a protein substance. The gluten flours contain very small percentages of carbohydrates.

Gluten A contains 87% of gluten and 4% of carbohydrates

Gluten B contains 85% of gluten and 7% of carbohydrates.

Gluten C contains 83% of gluten and 12% of carbohydrates.

Hoyt's Gluten Special Flour

This contains 80% gluten flour, 1% of fat, and less than 5% of starch. It is used in the preparation of gruels and muffins.

Lister's Prepared Casein Diabetic Flour

This consists of milk casein, a protein of milk, to which acid calcium phosphate, sodium bicarbonate and sodium chloride is added as a leavening mixture. A very small amount of saccharin is added for sweetening purposes. It is used in preparing muffins, biscuits, cakes, bread, cookies, etc.

Diaprotein Prepared Casein Flour

This is a preparation consisting largely of casein like Lister's flour, to which has been added 4% of a leavening mixture consisting of sodium bicarbonate, mono calcium phosphate and sodium aluminium sulphate.

Soy Bean Gruel Flour

This is a flour prepared from the soy bean. It contains 44% protein, 20% fat, 10% sucrose. It is used in the treatment of diabetes and obesity, and when starchy foods cannot be digested.

Hepco Flour

This is a flour prepared from soy bean and contains protein 42.9% and carbohydrate 22.4%. Only half of this carbohydrate is changed to sugar. It is used in the preparation of cakes, muffins, etc. It is used in diabetes and also in digestive disturbances in which starchy foods cannot be digested.

Cellu Flour

This is a pure cellulose which is an indigestible fibrous carbohydrate substance which helps to form the bulk of the stool. It is used principally to increase the bulk of low diabetic diets. It is used together with mineral oil, or bran for the preparation of imitation bread, muffins, cakes, cookies, pies, etc.

PREPARATIONS OF FATS

The food substances consisting largely of fat are the various oils such as olive oil and the fats contained in cream, butter, etc. When large quantities of fat are needed these foods may be added to the diet. Cod liver oil, which consists largely of fat, is used principally because it contains large quantities of vitamins (see page 377).

INTARVIN FAT

This is a fat-like substance made chemically, to which 12% of mineral oil has been added. It is used as a substitute for fat, cream and butter in the diet of diabetic patients to prevent and relieve the acidosis. This is a condition in which the alkalinity of the blood is diminished and the urine shows acetone and diacetic acid constantly.

Mode of Action

The fat in the body is usually broken down to simpler acid substances which are finally burned up as carbon dioxide and water. In some cases of diabetes, the fats cannot be completely oxidized so that the acid substances formed from fats are retained in the blood and diminish the alkalinity of the blood. If this condition persists the symptoms of diabetic coma result, which may be fatal.

It has been shown that the acid substances formed from fats in the body have an even number of carbon atoms. Intarvin is a fat-like substance which, in the process of oxidation forms acids in the body that have an odd number of carbon atoms. Such fats do not lessen the alkalinity of the blood and do not tend to produce acidosis.

VITAMINES

Vitamines are elements contained in foods which are essential for growth and development, nutrition and other physiologic processes. They have not been isolated, but we can recognize their presence or absence in the food, by the disturbances in growth, nutrition or other symptoms which result when they are deficient in the diet. There are two kinds of vitamins: those soluble in fat and those soluble in water. The fat soluble vitamin, fat soluble A, is necessary for growth and nutrition. It occurs in butter, egg yolk, in cod liver oil and in the yellow fat of animals, as well as in carrots, potatoes and bananas. Rickets, and Xerophthalmia, a peculiar disease of the eye, are believed to be due to a deficiency of fat soluble A vitamins in the diet. The water soluble vitamins are of two kinds, B and C. They are necessary for appetite and nutrition. Water soluble C vitamin is found in beef, in glandular tissues such as the kidney and pancreas, in corn, tomatoes, oranges and lemons. When this vitamin is absent, scurvy results. This is a condition characterized by pains in the joints and bleeding of the gums.

Water soluble B vitamin is present in the outer shell of cereals, in oranges and in yeast. When this vitamin is absent, certain diseases of the nerves result. Beri beri is a disease which is believed to be due to the absence of such vitamins in polished rice. Pellagra is also believed to be due to a vitamin deficiency. Vitamin deficiencies are better treated by a properly balanced diet, than by vitamin-containing preparations.

COD LIVER OIL (OLEUM MORRHUAE)

Cod liver oil is obtained from the livers of various species of codfish, especially the *Gadus morrhua*.

It consists of the various fats: olein, stearin, and palmitin, and some fatty acids. It also contains very small quantities of iodine,

chlorine, bromine, phosphorus, and is very rich in fat soluble vitamins.

The livers were formerly allowed to decompose, and the oil which formed was then collected. At the present time, the cod liver oil is obtained by forcing steam under pressure through the livers, to express the oil. This oil is pale in color and less nauseating than the oil formed by the old method. There are three varieties of cod liver oil: the dark, the light brown, and the pale yellow.

Cod liver oil was used for many years by the fishermen of the North Sea as a remedy for children's diseases. It is now very extensively used in medicine.

Action: Cod liver oil improves the general condition of the patient if given for some time. It stimulates nutrition and the growth of bone in children. It increases the appetite, and makes the patient stronger and stouter. Its effect depends largely upon the fat soluble vitamins which it contains. In addition to the effect of the vitamins, cod liver oil is digested in the intestines, and is then deposited as fat in the various tissues and organs of the body.

In overdoses, it causes nausea; occasionally, vomiting and diarrhoea.

Uses: Cod liver oil is given principally in "run down" conditions, in rickets and in chronic wasting diseases, such as tuberculosis. It is often given together with malt or creosote. It is usually given only in winter; patients dislike it during the summer months.

Administration

The unpleasant taste and odor of cod liver oil can be disguised in the following ways:

1. By giving the oil in wine, or in lemon juice, in the same way as castor oil (see castor oil).
2. By taking a little peppermint, and then putting the cod liver oil in the mouth without allowing the lips to touch it, so that the smell does not reach the nose.
3. By giving the emulsions of cod liver oil which have a more pleasant taste. They should be fresh, however, as they spoil very easily.

All preparations of cod liver oil should be given about three quarters of an hour to an hour after meals, the time when most digestion takes place.

In children, when it cannot be given by the mouth, cod liver

oil may be rubbed on the skin of the chest or abdomen, before retiring, as it is readily absorbed from the skin.

Preparations

Cod Liver Oil (<i>Oleum Morrhuae</i>)	2.0-16.0 c.c.	3½-iv
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Emulsion of Cod Liver Oil (<i>Emulsum Olei Morrhuae</i>)	4.0-16.0 c.c.	3i-iv
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This contains 50% of cod liver oil.

Emulsion of Cod Liver Oil with Hypophosphites (<i>Emulsum Olei Morrhuae cum Hypophosphitibus</i>)	4.0- 8.0 c.c.	3i-ii
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There are numerous preparations of cod liver oil on the market combined with preparations of phosphorus, iron, etc.

YEAST

Yeast is a substance consisting of small unicellular organisms, *Saccharomyces Cerevisae*. It is also known as brewer's or baker's yeast. Dry yeast is obtained by growing yeast with malted grains such as barley, then filtering and drying the sediment.

Action: Yeast is very rich in water soluble vitamine B. It stimulates nutrition and has a laxative effect. It sometimes produces considerable distention, especially in children, due to fermentation in the intestines.

Yeast is used as a tonic, to supply a vitamine deficiency, as a laxative, and in furunculosis, a condition characterized by the formation of pimples. It is occasionally used in the preparation of meat extracts, soups and bouillons. The dose is 1 or 2 cakes three times a day. There are numerous preparations on the market containing various combinations of vitamins, such as **metagen**, etc.

It should be remembered that an average well-balanced diet is much richer in vitamins than the average doses of yeast.

MINERAL SALTS

Mineral salts are often used to relieve symptoms due to deficient utilization or assimilation of these salts in the body. The most commonly used mineral salts for this purpose are the preparations of **calcium** and **phosphorus**.

CALCIUM

Calcium or lime is used in medicine in the form of various salts. It is necessary for the growth of bone, for the regulation of nervous, muscular and glandular activity, as well as for the coagulation of blood.

Action

Calcium produces the following effects:

1. When given by mouth it neutralizes the acid in the stomach and lessens nausea and vomiting.
2. It increases the coagulability of the blood.

3. It lessens the irritability of the nervous system and relaxes spasms of the involuntary and voluntary muscles.

4. It increases the growth of bone by supplying the necessary calcium.

5. It lessens transudation of serum into the tissues, which often produces urticaria or hives. This may result from the injection of a serum or from various proteins (allergic reaction) (see page 460). In a similar manner it sometimes relieves profuse diarrhoea.

Uses

Calcium is used in hemorrhage and in haemophilia or purpura, conditions in which the coagulability of the blood is diminished.

It is also used in tetany, a condition characterized by muscular spasms, due to deficiency of the parathyroid glands.

It is used in asthma, in hay fever and in urticaria, since it is thought that a deficiency of calcium may be a causative factor in these conditions.

It is also used in other nervous conditions characterized by twitchings or spasms of the stomach or muscles of the intestine, which are believed to be due to a deficiency of calcium.

Administration

It is given by mouth in solutions or in capsules, and by intravenous injections.

Preparations

For Internal Use

Lime Water	30.0-120.0 c.c.	℥i-iv
Solution of Calcium Hydroxide (Liquor Calcii Hydroxidi) (Liquor Calcis)		

This is a saturated solution of calcium hydrate or slaked lime, containing 0.17 Gm. of calcium hydrate to 100.0 c.c. of water. It is made by washing slaked lime with distilled water, and then filtering the resulting solution. It is used to neutralize the acid in the stomach, to soothe the stomach and to lessen nausea and vomiting. It is very constipating. When added to milk, it lessens curdling in the stomach and makes the milk more digestible.

Calcium Chloride (Calcii Chloridum)	0.3-1.0 Gm.	grs. v-xv
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This is used to increase the clotting of the blood. It is somewhat irritating to the tissues, however. When fresh it is a good antiseptic, ℥vi of the calcium chloride being used to a gallon of water. It is injected intravenously in a 5% solution.

Calcium Lactate (Calcii Lactas)	0.2-0.6 Gm.	grs. iii-x
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This is used principally to increase the clotting of the blood in haemorrhage. It is frequently given for several days before tonsil and adenoid operations to prevent profuse bleeding. It is occasionally given hypodermically.

Calcium Sulphide 0.06 Gm. gr. i
(Calcii Sulphas)

This is given for acne.

Afenil
(Chlor Calcium Carbamide)

This is a salt of calcium chloride and urea, containing about 11.42% calcium and 68.28% of urea. It is given for hay fever, urticaria, excessive menstrual bleeding, painful menstruation, spasmodic abdominal cramps, and tetany, on the basis that these conditions are due to a disturbance of calcium in the body. It comes in ampoules of 10 c.c. It is injected intravenously or intramuscularly. It causes flushing of the face and neck while it is being administered.

For Local Use

Lime Liniment
(Linimentum Calcis)
Carron Oil

This is a mixture of lime water and olive or linseed oil in equal parts.

PHOSPHORUS

Phosphorus is a non-metallic element obtained from bones by the action of sulphuric acid and water. It is a semi-solid, soft, wax-like, colorless or yellowish substance, which emits light in the dark, and has an odor of garlic.

Phosphorus is found in the body in many tissues, especially in nerve and bone tissue. In nerve tissue, phosphorus is present in large quantities combined with fats. These substances are called lecithins, or phosphorized fats. In the bones, phosphorus is combined with calcium, sodium, or magnesium.

Action

1. The principal effect of phosphorus is to increase the growth of bone. It increases the growth of bone-forming cells (osteoblasts) and makes the spongy part of the bone (the cancellous tissue) more firm and hard.

2. It slightly increases the formation of red blood cells but it does not increase the haemoglobin.

3. It is said to improve the nutrition of nerve tissue by supplying them with their necessary phosphorus. The hypophosphites and glycerophosphates are the preparations used for this purpose.

Uses

Phosphorous preparations are used in the following conditions:

1. As a nerve tonic in nervous diseases, such as neurasthenia, and other functional diseases.
2. To harden the bones in rickets, osteomalacia, etc.
3. To increase sexual activity.

Poisonous Effects

Phosphorus poisoning occurs in two forms: acute poisoning and chronic poisoning.

Acute Phosphorus Poisoning

Acute phosphorus poisoning usually results from phosphorus taken accidentally or with suicidal intent. The red phosphorus is more poisonous than the yellow. Many pastes used to destroy vermin, or match heads which contain phosphorus, are the substances sometimes taken.

Symptoms

The following are the characteristic symptoms which appear in about three to twelve hours. If an oily solution, or a paste is taken, they appear more rapidly; if the preparation is a solid one, they appear later.

1. Abdominal pain, nausea, vomiting and diarrhoea. The vomitus and stools, as well as the urine emit light when held in the dark and have an odor of garlic.

2. Jaundice.

3. Collapse and coma.

All the symptoms of phosphorus poisoning are due to the destruction of many of the cells in some of the organs of the body. The cell substances are changed to fat globules with which they become filled. For example, the jaundice is due to the broken-up liver cells which block up the bile ducts in the liver, and the bile is then dammed back into the blood.

Death from phosphorus poisoning has resulted from 0.04—0.12 Gm. (grs. $\frac{3}{4}$ —ii.) and has occurred in a few hours to a few weeks.

Treatment

1. Old common crude turpentine, or French acid turpentine, about 2.0 c.c. ($3\frac{1}{2}$) every fifteen minutes is given as an antidote. This forms a hard solid mass with the phosphorus, and prevents its absorption.

2. Occasionally, hydrogen peroxide, or potassium permanganate, may be given to oxidize the phosphorus.

3. Copper sulphate may be given to produce vomiting. It is also an antidote, and is best given in two grain doses every five minutes, until vomiting is produced. After that gr. $\frac{1}{2}$ may be given every twenty minutes as long as ordered.

4. The stomach should be washed out.

5. Give cathartics, especially salines such as hydrated magnesia.

6. Protect the mucous membrane with albuminous drinks as the white of egg, etc.

7. Do not give oils or fats, as these hasten the absorption of the phosphorus.

8. The collapse is treated with stimulants.

Chronic Phosphorus Poisoning

Chronic phosphorus poisoning usually occurs as a result of continually inhaling the phosphorus fumes, in individuals who work in phosphorus match factories. It occurs particularly from the use of the yellow phosphorus, which has now mostly been given up, and the symptoms are therefore now rarely seen.

The symptoms usually begin with a carious tooth, or a sore gum. The gums become swollen and painful, abscesses of the jaw often form, with destruction of pieces of the jaw bone. Occasionally there may be slight jaundice, anaemia, diarrhoea, albumin in the urine, etc.

Thorough ventilation of the factories where phosphorus is used, to get rid of the fumes, and the inhalation of the crude turpentine, usually prevents the condition.

When abscesses of the jaw form, they must be treated surgically.

Preparations

Pill of Phosphorus

(Pilulae Phosphori)

Each pill contains 0.0006 Gm. (gr. $\frac{1}{100}$) of phosphorus.

Syrup of Hypophosphites

4.0-8.0 c.c.

℥i-ii

(Syrupus Hypophosphitum)

This contains the hypophosphite of calcium, sodium and potassium, also the tincture of lemon peel and sugar.

Compound Syrup of Hypophosphites

4.0-8.0 c.c.

℥i-ii

(Syrupus Hypophosphitum Compositus)

This contains iron hypophosphite in addition to the ingredients in the syrup of hypophosphite.

The following preparations are made from **glycerophosphoric acid**:

Calcium Glycerophosphate

0.2-0.6 Gm.

grs. iii-x

(Calcii Glycerophosphas)

Various syrups and wines of glycerophosphates are on the market. Many of them are combined with iron. They are all good tonics.

Lecithin

This is a phosphorized fat. It consists of various salts of fatty acids such as oleic, stearic and palmitic acids, combined with glycerophosphoric acid and various protein substances. It is present in large quantities in nerve tissue. It is also present in various foods, especially in egg yolk and in many vegetable foods. For medicinal purposes, it is made from egg yolk.

Lecithin increases the nutrition of the body, though it is not nourishing in itself. It increases the number of red blood corpuscles and the haemoglobin. It is used principally as a tonic and in exophthalmic goiter. It is given by mouth in doses of 0.1-0.5 Gms. (gr. $i\frac{1}{2}$ -viii) in pills, or hypodermically in doses of 1.0 c.c. (m. xv), from 15% solutions in oil.

Lecithin Solution

4.0 c.c.

℥i.

This is a 2% solution of lecithin in glycerin and alcohol. Its action and uses are the same as those of lecithin.

Alteratives are drugs which were formerly used extensively to improve nutrition. Sarsaparilla, sassafras, guaiac, mercury and gold were the substances used.

PART IX—DRUGS ACTING ON THE UROGENITAL TRACT

CHAPTER XXIX

DIURETICS

(Kidney Stimulants)

Physiology of the Kidneys

The urine is excreted by the kidneys. The fluid part of the urine is formed by some of the fluid of the blood passing into the tubules of the kidneys at the glomeruli (where capillary blood vessel and tubule meet), which are situated at the cortex. In its passage along the tubules of the kidneys this fluid becomes filled with dissolved substances. These are abstracted from the blood by the direct action of the cells lining the tubules, or by salt action.

Classification

Diuretics are drugs which increase the flow of urine. They may be divided into the following four groups according to the method in which they increase the secretion of urine.

1. Cell Stimulating Diuretics
2. Irritant Diuretics
3. Circulatory Diuretics
4. Saline Diuretics

Cell Stimulating Diuretics are drugs which increase the flow of urine by directly stimulating the cells of the kidney to excrete more urine.

Irritant Diuretics are drugs which increase the secretion of urine by irritating (injuring) the cells of the kidney and therefore making them secrete more urine. In large doses these substances may cause inflammation of the kidney.

Circulatory Diuretics are drugs which increase the secretion of urine by improving the circulation in the kidneys so that more fresh blood is constantly being brought to them from which to form urine. This effect may result from the action of a drug on the heart, as from digitalis. It may also result from widening (dilating) the blood vessels of the kidneys so that the blood flows more freely through them. The nitrites increase the secretion of urine in this manner.

Saline Diuretics are inorganic salts used as diuretics. Only the salts which are absorbed are able to increase the secretion of urine. They act in the following manner: When the salts enter the blood they increase its percentage of salt and the osmotic power of the blood is thus increased. As a result, fluid is withdrawn from the tissues into the blood, until it contains an excess of fluid. This excessive fluid then passes from the small blood vessels of the kidneys into the tubules, at the glomeruli, thus increasing the secretion of urine.

Diuretics may also be classified according to their chemical nature, as **saline diuretics, alkaline diuretics, vegetable diuretics, etc.**

CELL STIMULATING DIURETICS

CAFFEINE

Caffeine increases the secretion of urine by directly increasing the action of the kidney cells and probably also by the improvement of the circulation.

THEOBROMINE

Theobromine is a white powder, an alkaloid, obtained from the seeds of the **Theobroma cacao**, the chocolate tree of South America. It is very closely related, chemically, to caffeine. Its action is similar to that of caffeine.

Theobromine acts like caffeine, but it differs from it in affecting the heart muscle only slightly, it does not stimulate the brain, and it is a more effective diuretic. It is slowly absorbed and acts principally on the kidneys as a diuretic, increasing the flow of urine.

Since theobromine and its salts are rapidly eliminated, they are best given in small doses, frequently repeated (about every two hours), when a continual effect is desired.

Preparations

Theobromine	0.3-1.0 Gm.	grs. v-xv
(Theobromina)		

This preparation is apt to upset the stomach.

Theobromine Sodium Salicylate	0.3-1.0 Gm.	grs. v-xv
(Theobrominae Sodii Salicylas)		
(Diuretin)		

This preparation is very frequently given as a diuretic, and it is more soluble than the others.

Theobromine Sodium Acetate (Theobrominae Sodii Acetas) (Agurin)	0.3-1.0 Gm.	grs. v-xv
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THEOPHYLLIN

Theophyllin is the active principle of tea leaves. Its action is similar to that of caffeine. It is occasionally used to increase the flow of urine.

Theophyllin Sodium Acetate (Theophyllinae Sodii Acetas)	0.2-0.3 Gm.	grs. iii-v
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THEOCIN

Theocin is artificial theophyllin. It is used to increase the flow of urine.

Theocin (Theocinae)	0.2-0.3 Gm.	grs. iii-v
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IRRITANT DIURETICS

The following drugs are obtained from various plants and act as diuretics:

JUNIPER

Juniper is obtained from the unripe, full-sized berries of the **Juniper communis**, or juniper plant. Its active principle is a volatile oil, the oil of juniper which is obtained by distilling the berries.

Action: Juniper is irritating to the skin and mucous membranes if applied locally.

When given by mouth, it increases the appetite, aids digestion and increases the flow of urine. Juniper is used principally to increase the flow of urine.

It is rarely given alone. It is usually combined with cream of tartar or other alkaline diuretics.

Overdoses of juniper usually cause painful urination with bloody urine.

Preparations

Oil of Juniper (Oleum Juniperi)	0.2-1.0 c.c.	m. iii-xv
Spirit of Juniper (Spiritus Juniperi)	2.0-4.0 c.c.	m. xxx- 3i

Compound Spirit of Juniper
(Spiritus Juniperi Compositus)

This is similar to gin and contains juniper, caraway and fennel.

Scoparius, Buchu and Triticum are irritant diuretics which are given in the form of a decoction.

Anasarcin

This is a proprietary preparation used as a diuretic. It contains scillotoxin 0.0006 Gm. (gr. $\frac{1}{100}$) and scillipieridin 0.015 Gm. (gr. $\frac{1}{4}$), two glucosides obtained from squills, and Oxydendrin arboreum 0.04 Gm. (gr. $\frac{3}{4}$) and Sambucis canadensis 0.04 Gm. (gr. $\frac{3}{4}$) two other irritant diuretics.

MERCURY SALTS

The following salts of mercury are often used to increase the flow of urine.

Calomel (Hydrargyri Chloridum Mite)	0.015-0.15 Gm.	grs. $\frac{1}{4}$ -ii
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As a diuretic, calomel is often given in the form of Guy's or Fothergill's pill, which contains calomel, squills and digitalis, 0.06 Gm. (gr. i) of each.

Bichloride of mercury, in small doses, also increases the flow of urine. In poisonous doses, it severely irritates the kidney cells and lessens secretion of urine.

Novasurol

This is a complex chemical compound of mercury and sodium acetate containing about 33% of mercury. It is used as a diuretic, producing a profuse flow of urine. It is given intravenously or intramuscularly. It may produce symptoms of mercury poisoning, such as sore gums, abdominal cramps and diarrhoea. It comes in ampoules each containing 1.2 c.c.

CIRCULATORY DIURETICS

The following drugs increase the flow of urine by improving the circulation in the kidneys. The circulatory diuretics are of two kinds: **heart stimulants and vaso dilators.**

The heart stimulants make the heart beat stronger so that the blood is kept circulating more freely. More blood is therefore brought to the kidneys more frequently, and the secretion of urine is increased.

The vaso dilators are drugs which dilate the blood vessels of the kidneys, thus improving their circulation and increasing the secretion of urine.

Heart Stimulants Acting as Diuretics

Digitalis
Strophantus
Squills
Apocynum

For their effects see heart stimulants, pages 217, 222, 223.

Vaso Dilators Acting as Diuretics

The Nitrites

For their effects, see page 236.

SALINE DIURETICS

The following mineral salts are frequently used to increase the flow of urine. Many of them are also used as alkalies and to produce other effects.

Action

The saline diuretics affect principally the stomach, intestines and the kidneys. Most of them are readily absorbed.

Action in the stomach: Because of their alkaline reaction, diuretic salts neutralize the acid in the stomach.

Action in the intestines: Most of the saline diuretics also act as cathartics. They produce frequent fluid movements of the bowels. For this effect they must be given in somewhat larger doses than for a diuretic effect.

Action on the kidneys: The saline diuretics increase the flow of urine. They increase the salt concentration of the blood, and therefore its osmotic power (the ability to abstract fluid). As a result, fluid is withdrawn into the blood from the tissues. The excess of fluid in the blood is then eliminated by the kidneys, thus increasing the secretion of urine. Some of the preparations make the urine more acid while others make it more alkaline.

Administration

The saline diuretics should be given well diluted in the morning when the stomach is empty.

Preparations

Potassium Salts

Potassium Acetate (Potassii Acetas)	0.06-0.6 Gm.	grs. i-x
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This is a salt of potassium and acetic acid.

Potassium Bitartrate (Potassii Bitartaras) (Cream of Tartar)	0.6-4.0 Gms.	grs. x-3i
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This is a salt of potassium and tartaric acid. It is usually given in hot water, flavored with lemon juice. It is rarely given alone, usually together with the infusion of juniper.

Potassium Citrate (Potassii Citras)	0.6-1.3 Gm.	grs. x-xx
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This is not as unpleasant to take as the other potassium salts. It increases the secretion of sweat (diaphoretic action), as well as the secretion of urine.

Solution of Potassium Citrate (Liquor Potassii Citratis)	15.0-30.0 c.c.	3½-i
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This contains about 8% of potassium bicarbonate, and about 6% of citric acid.

Effervescent Potassium Citrate (Potassii Citras Effervescens)	2.0-4.0 c.c.	3½-i
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This consists of potassium citrate 20%, potassium bicarbonate and sugar.

Effervescent Draught

This is made by mixing a solution containing 4.0 Gms. (3i) of potassium bicarbonate in 90 c.c. (3iii) of water, with a 50% solution of lemon juice in water. The quantities used depend on the dose ordered.

Other potassium salts which are occasionally used as diuretics, are potassium bicarbonate and potassium sulphate.

Sodium Salts

The principal salt of sodium that is used to increase the flow of urine is sodium acetate.

Sodium Acetate (Sodii Acetas)	0.6-4.0 Gms.	grs. x- $\bar{z}$ i
Sodium Acid Phosphate (Sodii Biphosphas)	1.0-1.3 Gm.	grs. xv-xx

This is given to make the urine acid in reaction and is frequently given together with urotropine. In large doses it is a laxative.

Lithium Salts

The salts of lithium produce the same effects as the potassium salts. Their principal effect is to increase the flow of urine.

They are said to dissolve crystals in the urine and to prevent the formation of stones in the kidney in this way.

Lithium Benzoate (Lithii Benzoas)	0.3-1.0 Gm.	grs. v-xv
Lithium Citrate (Lithii Citras)	0.3-1.0 Gm.	grs. v-xv
Effervescent Lithium Citrate (Lithii Citras Effervescens)	4.0-8.0 Gms.	$\bar{z}$ i-ii

This contains citric acid, lithium carbonate, sodium bicarbonate and sugar.

PHENOLSULPHONEPHTHALEIN

This is a chemical which is excreted in the urine and is used in testing the function of the kidneys. When it is injected intramuscularly, 65 to 85% of the quantity injected is eliminated by the kidneys in one hour. The failure to eliminate a sufficient amount of the injected quantity, or a slow elimination is an indication of disturbed kidney function.

An ampule containing 0.006 Gm. (gr. $\frac{1}{160}$) is injected intramuscularly or intravenously. The patient is given 200-400 c.c. of water before the injection. The urine is then collected every half hour, and is tested with a specially prepared 25% sodium hydroxide solution. The depth of the red color is compared with a standard scale, to determine the percentage of phenolsulphonephthalein eliminated.

URINARY ANTISEPTICS

Urinary antiseptics are drugs used to treat infections along the urinary tract such as the bladder, the pelvis of the kidney or the ureters. There are two kinds of substances used for this purpose:

1. Antiseptics applied by direct injection into the urinary tract.
2. Antiseptics given by mouth which are eliminated in the urinary tract.

The antiseptics applied locally are **Colloidal silver preparations** such as **Protargin** solutions, and **Mercurochrome 220**. These are described under antiseptics, see pages 69 and 72.

The antiseptics eliminated in the urine are substances given by mouth, which act as antiseptics or germicides in the urinary tract, such as the pelvis of the kidneys, the ureters or bladder. The substances used commonly for this purpose are the following:

Hexamethylenamine (Urotropine).

Benzoic Acid, and its salts

Methylene Blue

and various substances containing volatile oils such as sandalwood, etc.

HEXAMETHYLENAMINE (UROTROPINE)

Hexamethylenamine or urotropine is an artificial chemical substance used principally as a urinary antiseptic.

Action

Hexamethylenamine liberates formaldehyde in the urine, which disinfects the urine and the mucous membranes of the genito urinary tract with which it comes in contact. It only acts when the urine is acid and is therefore given together with sodium benzoate or sodium acid phosphate which make the urine acid.

It has also been used in various infectious diseases because of the formaldehyde gas which it liberates in the blood and secretions. It has frequently been injected into the spinal canal for meningitis.

Large doses occasionally cause burning pain in the stomach, pain on urination, and the urine occasionally contains blood.

Preparations

Hexamethylenamine (Urotropine)	0.2-0.6 Gm.	grs. iii-x
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This preparation is also on the market under the following names:

Formin	0.3 Gm.	grs. v
Aminoform	0.3 Gm.	grs. v
Amphotropin	0.3 Gm.	grs. v

This is a compound of camphoric acid with a derivative of hexamethylenamine. It is a urinary antiseptic, a diuretic and it increases the excretion of uric acid.

Hexalet (Hexamethylenamine Salicylsulphonic Acid)	0.3-1.0 Gm.	grs. v-xv
Helmitol (Hexamethylenamine Methylencitras)	0.3-1.0 Gm.	grs. v-xv

Saliformin (Hexamethylenamirae Salicylas)	0.3-2.0 Gms.	grs. v-xxx
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BENZOIC ACID AND BENZOATES

Benzoic acid or flour of benzoin is an organic acid obtained from benzoin, the hardened sap of the *Styrax benzoini*, a Peruvian tree. It is one of the oldest antiseptics known. It was probably combined together with cinnamic acid, a closely related substance, in the balsams which the Egyptians used to embalm their dead. The excellent preservation of their mummies, even today, attests to the efficacy of these substances as preservatives.

Action: Applied locally to the skin or mucous membranes, benzoic acid and its salts act as antiseptics. They also increase the secretions of the mucous membranes.

When given by mouth, they act as intestinal antiseptics. After absorption they increase the secretions, especially the secretions of the bronchial tubes, and the sweat. Benzoic acid and its salts are eliminated in the urine, which they make more acid in reaction. They also act as an antiseptics in the urinary tract.

Preparations

Benzoic Acid (Acidum Benzoicum)	0.3-1.0 Gm.	grs. v-xv
Sodium Benzoate (Sodii Benzoas)	0.3-2.0 Gms.	grs. v-xxx

This is used principally as a urinary antiseptic and as a preservative in canned foods.

Lithium Benzoate (Lithii Benzoas)	0.3-2.0 Gms.	grs. v-xxx
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METHYLENE BLUE (METHYLTHIONINAE HYDROCHLORIDUM)

Methylene blue is a chemical substance which forms a deep blue solution in water. It is used principally as a urinary antiseptic in gonorrhoea, and as a specific for malaria. It stains the urine a blue or dark green color. It is given in capsules, in doses of 0.1-0.5 Gm. (grs. $\frac{1}{2}$ -viii.)

URINARY ANTISEPTICS CONTAINING VOLATILE OILS

The following substances which contain volatile oils are used as urinary antiseptics:

Action: When given by mouth they produce the following effects:

1. They act as carminatives in the gastro-intestinal tract, checking the formation and aiding in the expulsion of gas.
2. They increase the flow of urine and they act as antiseptics in the urinary tract where they are eliminated.

They are used principally in cystitis and gonorrhoea.

Preparations

Sandalwood Oil

This is a volatile oil distilled from the wood of *Santalum album*, an American tree.

Oil of Sandalwood (<i>Oleum Santali</i>)	0.6–1.0 c.c.	m. x–xv
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Santalol or Arheol	0.2–0.6 Gm.	grs. iii–x
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This comes in capsules and is less irritating than the sandalwood oil itself.

Santalol Salicylate or Santyl (<i>Santalolis Salicylas</i>)	0.5–1.5 Gm.	m. viii–xxv
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This comes in capsules each containing 0.5 Gm. It is less irritating than sandalwood oil and changes into santalol and salicylic acid in the intestinal tract.

Uva Ursi, Bearberry

This is obtained from the leaves of *Arctostaphylos Uva Ursi*, an evergreen shrub growing in Northern Europe and the United States. Its active principle is a glucoside *arbutin*. It is a urinary antiseptic and diuretic.

Fluidextract of Uva Ursi (<i>Fluidextractum Uvae Ursi</i>)	1.0–4.0 c.c.	m. xv–3i
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Arbutin (<i>Arbutinum</i>)	0.2–0.5 Gm.	grs. iii–viii
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Copaiba

This is an oleoresin obtained from the sap of *Copaiba Langsdorfii*, a tree which grows in Brazil and other South American countries. It is given in doses of 0.6–2.0 Gms. (grs. x–xxx).

Oil of Copaiba (<i>Oleum Copaibae</i>)	0.6–1.0 c.c.	m. x–xv
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CHAPTER XXX

DRUGS WHICH ACT ON THE UTERUS

The drugs used principally for their effects on the uterus may be divided into the following three groups:

Ecbolics or Oxytocics (Uterine Muscle Stimulants)

Emmenagogues

Uterine Sedatives (Uterine Muscle Depressants)

Ecbolics or Oxytocics are drugs which are used to contract the uterus, and to expel its contents.

Emmenagogues are drugs which are used to increase, or to cause menstruation, when its absence is due to causes other than pregnancy.

OXYTOCICS

The drugs used chiefly to contract the uterus are the following:

Ergot

Pituitrin

Hydrastis

Stypticin

ERGOT (ERGOTA)

Ergot is a black parasitic fungus, which grows on the rye plant, **Secale cereale**, the fungus taking the place of the rye grain. The active principles are the alkaloids: **ergotoxine**, **ergotine** and **tyramine**.

Appearance of the Patient

Ergot is usually given to patients for bleeding from the uterus, or to contract the uterus immediately after childbirth.

Within fifteen minutes to a half hour after a dose of a preparation of ergot is given, the patient usually complains of violent cramp-like pains in the lower part of the abdomen, particularly in the region of the uterus. If there has been bleeding from the uterus, this is gradually lessened.

There may be nausea, and later, frequent movements of the bowels. The pulse is usually slow and strong.

ACTION

Local Action: When given hypodermically, ergot is quite irritating and is apt to cause an abscess at the site of injection. It is irritating to mucous membranes.

Internal Action

In the mouth: Ergot has a very unpleasant taste. It often increases the flow of saliva because of the irritation of the mucous membrane of the mouth.

In the stomach: All the preparations except the active alkaloïds may cause nausea and vomiting.

In the intestines: Ordinary doses lessen peristalsis. Poisonous doses increase the secretions and peristalsis of the intestines, causing frequent bowel movements.

Action after Absorption

Ergot is rapidly absorbed into the blood through the mucous membrane of the stomach and intestines. Its effects usually appear within a half hour. After absorption, it affects principally the uterus and the circulation.

Action on the uterus: This is the most important action of ergot. Ergot increases the contractions of the uterus. It produces wave-like contractions of the uterine muscles, which expel the contents of the uterus. It does not always start uterine contractions, but it always increases them when they are once started. By contracting the uterus, ergot contracts its blood vessels and stops uterine bleeding.

Action on the heart: Ergot makes the heart beat slower, principally as a result of its effects on the blood vessels. The pulse of ergot is slow and strong.

Action on the blood vessels: It contracts the blood vessels, raising the blood pressure. The effect is due to the ergotoxine and tyramine and is similar to that of epinephrine or pituitrin, but is not as marked.

Action on secretions: The secretion of sweat and milk is lessened.

Excretion

The exact mode of excretion of ergot is unknown, but it is probably eliminated by the bowels and kidneys.

Uses

Ergot is used to contract the uterus, and to prevent or check uterine bleeding. It should always be given when the **uterus is empty**.

In labor cases it should always be given **after the third stage of labor**: that is, after the placenta is expelled. If given before the placenta is entirely expelled, the contractions of the uterus may cause pieces of the placenta to remain in the uterus, which may become infected and cause sepsis.

Ergot is frequently given to check bleeding from the lungs, from an ulcer in the stomach, or from an ulcer in the intestines in typhoid fever, etc. The bleeding is checked by the contractions of the bleeding vessels.

Ergotoxine and tyramine are used to increase the blood pressure.

Poisonous Effects

There are two forms of ergot poisoning: acute and chronic.

Acute Ergot Poisoning

Acute ergot poisoning is very rare and usually occurs from large doses of ergot, taken to produce abortion.

Symptoms

1. Cramp-like abdominal pain, vomiting and diarrhoea.
2. Bleeding from the uterus and abortion.
3. Haemorrhages into the skin.
4. Tingling and itching of the skin, or numbness.
5. Collapse (rapid, weak pulse, cold skin, slow and shallow breathing, etc.).

There may be convulsions before death.

Treatment

1. The stomach should be washed out.
2. The collapse is treated with heart stimulants, such as caffeine, strychnine, etc.

Chronic Ergot Poisoning

Chronic ergot poisoning results from eating rye bread made from rye infected with the ergot fungus. This is more apt to occur in the rye growing during wet seasons.

Ergot poisoning is very common in Russia and other northern countries, where a good deal of rye bread is eaten. In the mediaeval age plagues of ergot poisoning were quite common.

There are two forms of chronic ergot poisoning:

1. **The Gangrenous form**
2. **The Spasmodic form**

In some epidemics the gangrenous, and in others the spasmodic, form predominates.

Gangrenous Form

This is due to the persistent contractions of many of the blood vessels. As a result, various parts of the body, such as the fingers, the toes, ears or the tip of the nose may be deprived of their blood supply, and the part affected then dies and becomes gangrenous.

Symptoms: The limbs are first affected. **The fingers and toes become cold**, they lose their sensation, and become blue in color. **Soon they become hard and shriveled up and fall off**, without causing pain. Sometimes the gangrene spreads up over the extremities, and the forearm or leg may become gangrenous. Occasionally, areas of gangrene may form in the internal organs. **Ulcers in the stomach and intestines** may occur, because various areas of these organs are deprived of their circulation. **Ulcers of the cornea** of the eye may also result from the contraction of some of the small blood vessels leading to the cornea.

Nervous or Spasmodic Form

The symptoms of this form are believed to be due to spasms of the muscles in some of the small blood vessels of the brain. The contraction of some of these vessels obliterates the circulation in certain areas of the brain, thus causing the various symptoms. Some of the symptoms remain permanently.

Symptoms

1. Weakness and drowsiness.
2. Headache and dizziness.
3. Itching, and a feeling as if something were creeping over the limbs (formication).
4. Temporary or partial blindness.
5. Painful cramps in the limbs.
6. Clonic convulsions, followed by epileptiform convulsions. Insanity has been known to follow ergot poisoning.

The treatment varies with the symptoms.

Administration

Ergot has a very unpleasant taste which should always be disguised. It is best given after meals.

When given hypodermically, it should be injected deep into the muscles; and the part should be massaged very thoroughly afterwards.

Preparations

Ergot preparations should always be fresh, as they change very readily and become inactive if kept for any length of time.

There are a number of preparations of ergot on the market which are suitable for hypodermic use. There are other preparations which are not so nauseating and are more reliable than the standard preparations.

Fluidextract of Ergot (Fluidextractum Ergotae)	2.0-8.0 c.c.	$3\frac{1}{2}$ -ii
Wine of Ergot (Vinum Ergotae)	10.0-20.0 c.c.	$3\frac{1}{2}$ -v

This contains about 20% of ergot.

New and Non-official Preparations

Active Principles

Ergotoxine phosphate	0.0006-0.0012 Gm.	gr. $\frac{1}{100}$ - $\frac{1}{50}$
Ergotinine Citrate (Ergotininae Citras)	0.0003-0.0006 Gm.	gr. $\frac{1}{200}$ - $\frac{1}{100}$

This is an alkaloid which is changed in the body to ergotoxine and acts like ergot. It is given hypodermically.

Tyramine Hydrochloride	0.02-0.04 Gm.	gr. $\frac{1}{8}$ - $\frac{2}{3}$
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This is one of the active alkaloids of ergot; and is used to contract the uterus and to increase the blood pressure. It acts like epinephrine.

Solid Extracts

Purified Extract of Ergot: Extractum Ergotae Purificatum: (Bonjean's Ergotin)	0.2-0.5 Gm.	grs. iii-viii
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This is a purified extract of ergot about ten times as strong as ergot itself. It is often given hypodermically.

Ergotole	0.3-2.0 c.c.	m. v-xxx
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This is an excellent preparation made from specially cultivated Spanish ergot. It is about $2\frac{1}{2}$ times as strong as the fluidextract. It is suitable for hypodermic use.

Ernutin	2.0-4.0 c.c.	m. xxx-3i
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This is a reliable preparation of ergot, which has a pleasant taste. It is given hypodermically in doses of 0.3-0.6 c.c. (m. v-x).

Cornutol (Liquid Extractum Ergotae)	hypodermically by mouth	0.6-2.0 c.c. 0.6-4.0 c.c.	m. x-xxx m. x-3i
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This is a purified liquid extract in water to which 10% alcohol has been added.

Secacornin	0.5-1.0 c.c.	m. viii-xv
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This contains the active principles dissolved in water, glycerin and alcohol.

PITUITRIN OR PITUITARY LIQUID

Pituitary liquid or pituitrin is an extract made from the posterior lobe of the pituitary gland, a small gland situated at the base of the brain.

Appearance of the Patient

A few minutes after a hypodermic injection of pituitrin is given, the patient may complain of cramp-like abdominal pains, and pass a good deal of flatus. The pulse becomes slower and stronger and the patient looks pale. If it is given to a patient in labor, labor pains and uterine contractions are increased and the labor is hastened.

ACTION

Applied locally to mucous membranes it contracts the small blood vessels.

When taken by mouth it has practically no effect. It can produce effects, however, if used as a nasal spray.

When given hypodermically or intravenously, pituitrin acts principally on the circulation, the involuntary muscles and the uterus.

Action on the circulation : Pituitrin makes the heart beat slower and stronger and contracts the involuntary muscles of the small blood vessels, raising the blood pressure.

Action on the involuntary muscles : Pituitrin increases the contractions of involuntary muscles, particularly in the intestines, causing cramp-like pains and increasing the expulsion of gas. It also contracts the involuntary muscles of the blood vessels, raising the blood pressure.

Action on the uterus : It causes violent and more rapid contractions of the uterus, especially in labor. It is used principally to accelerate the birth of the child and to increase the strength and frequency of labor pains.

Specific Action :

Pituitrin is a specific for **diabetes insipidus**, a condition characterized by excessive thirst and the passing of enormous quantities of urine. It is believed to be due to a disturbance of the posterior lobe of the pituitary gland or the region of the brain in this area.

When pituitrin is given in this condition the thirst and the quantity of urine gradually become diminished. This effect may be produced even when it is sprayed in the nose with an atomizer.

Action on the kidneys : It increases the flow of urine, except in diabetes insipidus.

Action on secretions : It also increases the secretion of milk but it lessens the secretion of saliva and pancreatic juice.

Poisonous Effects

Pituitrin does not cause poisonous symptoms but large doses may cause very marked pallor and unusually high blood pressure. Rupture of the uterus has occurred in labor from excessive doses, especially when the pelvis was contracted.

Uses

1. Pituitrin is used principally to accelerate labor by increasing uterine contractions and to check uterine bleeding.

2. To increase the contractions of the intestines and to expel gas in abdominal distention following operations or in infectious diseases.

3. As a specific for diabetes insipidus.

Administration

Pituitrin is given hypodermically, intravenously, or by nasal spray.

Preparations

Solution of Pituitary (Liquor Pituitarii)	0.5–2.0 c.c. m. viii–xxx
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This is a standardized solution of the posterior lobe of the pituitary gland which comes in ampoules.

Pituitrin Solution of Hypophysis Pituitary Extract Pituglandol Pituitol	}	These are preparations of solution of pituitary. They come in two forms, obstetrical and surgical. The surgical is twice as strong as the obstetrical.
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These are three times as strong as the solution of hypophysis. They come in two forms, obstetrical and surgical. The surgical preparation is six times as strong as the solution of hypophysis.

QUININE

Quinine is used to increase uterine contractions. It has other more important actions, however, under which it will be described. (see page 402).

HYDRASTIS (GOLDEN SEAL)

Hydrastis is obtained from the roots and underground stems of *Hydrastis canadensis*, golden seal or yellow root. It is a small shrub growing in the United States. Its active principles are the alkaloids, *hydrastine* and *berberine*.

It acts like ergot, contracting the blood vessels and the uterus, but less powerfully.

It is used for the following effects:

1. As a bitter, to increase the appetite and aid digestion by increasing the secretion of the gastric juice.

2. To check uterine bleeding.

3. For constipation, to make the stools more fluid in character.

Preparations

Fluidextract of Hydrastis (Fluidextractum Hydrastis)	1.0-4.0 c.c.	m. xv-3i
Tincture of Hydrastis (Tinctura Hydrastis)	1.0-4.0 c.c.	m. xv-3i
Glycerite of Hydrastis (Glyceritum Hydrastis)	1.0-4.0 c.c.	m. xv-3i

This is used locally to relieve inflammations of the mucous membranes.

Hydrastine is rarely used, but an artificial alkaloid made from it, **hydrastinine**, is very frequently used.

Hydrastinine Hydrochloride (Hydrastininae Hydrochloridum)	0.01-0.03 Gm.	gr. $\frac{1}{6}$ - $\frac{1}{2}$
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This is an artificial alkaloid made by oxidizing hydrastine. It produces the same effect as hydrastis, but it is more efficient and the effects are more lasting. It is used to check uterine bleeding.

STYPTICIN (COTARNINE HYDROCHLORIDE)

Cotarnine hydrochloride, or stypticin, is an artificial alkaloid, made by oxidizing narcotine, one of the alkaloids of opium.

It contracts the blood vessels, and the uterus.

It is principally used to check bleeding from the uterus. It is also used to check bleeding from other parts of the body, such as the lungs, the stomach, or the intestines, by contracting the blood vessels of these organs. Gauze soaked in cotarnine is very frequently used by dentists to check bleeding.

Preparations

Cotarnine Chloride (Stypticin) (Cotarninae Chloridum, formerly Cotarnine Hydrochloride)	0.015-0.1 Gm.	grs. $\frac{1}{4}$ - $1\frac{1}{2}$
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It is given hypodermically in solution, or by the mouth in pills or tablets.

Cotarnine Phthalate (Styptol)

(Cotarninae Phthalas) Dose: Hypodermically 0.2 Gm. (grs. iii) dissolved in 2.0 c.c. (m. xxx) of water.

By mouth, 3 to 5 tablets a day. Each tablet contains gr. $\frac{3}{4}$ of the drug.

EMMENAGOGUES

Emmenagogues are drugs which increase menstruation.

Many drugs, such as iron, arsenic, or strychnine, which improve the general condition of the patient, may increase menstruation.

Many cathartics, such as castor oil or aloes, when given in large doses, and all the drastic purgatives, may increase menstruation.

Counterirritants, such as mustard or cantharides, when taken internally, sometimes increase menstruation.

Certain drugs, such as pennyroyal, apiol, etc., are used principally to increase menstruation. They all contain volatile oils which are their active principles. They may cause severe gastro-intestinal irritation.

UTERINE SEDATIVES

The following drugs are used principally to lessen contractions of the uterus, and to relieve painful menstruation.

Morphine

Atropine

Analgesic Antipyretics such as:

Acetanilid,

Antipyrine,

Phenacetine,

Pryamidon,

Viburnum.

VIBURNUM PRUNIFOLIORUM (BLACK HAW)

Viburnum is obtained from the root of the *Viburnum prunifoliorum* or black haw, a small American plant.

It lessens the contractions of involuntary muscles, especially the muscles of the uterus.

It is used principally to relieve painful or excessive menstruation, and to relieve the pains of ovarian disease.

Fluidextract of Viburnum Prunifoliorum
(Fluidextractum Viburni Prunifolii)

2.0-16.0 c.c.

$\mathfrak{z}\frac{1}{2}$ -iv

PART X—SPECIFICS

CHAPTER XXXI

SPECIFIC DRUGS

Specifics are drugs which are principally used to cure a particular disease. This effect is produced by destroying or neutralizing the causative agent of that disease. The best example of this action is the effect of quinine in malaria. The organism which causes this disease is destroyed by the quinine.

Many of the specifics relieve the symptoms of a particular disease, though the mode of action may be unknown. An example of such an action is the effect of the salicylates in rheumatism.

QUININE AND CINCCHONA

Quinine is a white powder, an alkaloid, the active principle of **cinchona**, or peruvian bark. This is the bark of the cinchona tree, which grows in the Andes or other mountainous districts on the western coast of South America. The tree has been cultivated successfully, however, in other parts of the world, in India and Java. There are two kinds of cinchona: **Cinchona rubra**, or red bark, and **Cinchona calisaya**, or yellow bark. They both produce the same effects, but the yellow bark contains more quinine.

Cinchona is named in honor of the Countess of Cinchon, a Spanish countess who was cured, in 1638, of a disease that was then known as the ague, but what we now know to be malaria. The drug had just been introduced in medicine at that time. It was brought to Spain by the Spanish explorers who learned of its use from the South American Indians. Besides **quinine**, the active alkaloid, cinchona contains the alkaloids, **quinidine**, **conquinine**, **cinchonine**, and **cinchonidine**. Their effects are similar to quinine but they are weaker, however.

Appearance of the Patient

When quinine is given to a patient suffering from malaria, it prevents the chills, fever and sweats which are characteristic of that disease.

After administration of a single average dose of quinine, the patient usually complains of its bitter taste. If there is fever, the temperature is lowered several degrees.

If the quinine is given for some time, the patient feels better, has a better appetite, the bowels move more regularly, he feels brighter and stronger and is more active. There is a gain in weight and the pulse is somewhat stronger and regular.

ACTION

Quinine affects all living tissues (protoplasm). It increases their activities at first, but soon lessens them. All the effects of quinine are due to this action. It has no selective action on any particular organ or tissue. It destroys various living organisms such as amoebae, bacteria, etc.

Local action: Applied to the skin or mucous membranes, quinine causes slight redness and acts as an antiseptic. It is not generally used as an antiseptic, because it is too expensive. It is said to increase the growth of hair and therefore forms an ingredient of many hair tonics.

Internal Action

In the mouth: Because of its very bitter taste quinine increases the appetite and the secretion of saliva.

In the stomach: It lessens the action of pepsin, thus retarding the digestion of protein food. In large doses, it occasionally causes nausea and vomiting.

In the intestines: It retards the action of the trypsin of the pancreatic juice, and increases the secretions and peristalsis, often causing frequent movements of the bowels.

Action after Absorption

Quinine is slowly absorbed into the blood, principally from the stomach. The presence of acid in the stomach aids the absorption. It begins to be absorbed in about 15 minutes, but the absorption is not complete until about four or five hours. When it enters the blood, it acts as a specific for malaria, and it slightly affects the nutrition and the action of all the tissues and organs.

Specific Action in Malaria

Malaria

Malaria is a disease caused by a unicellular protozoan organism, the *Plasmodium malariae*. This organism is injected into the

blood of the patient, when an individual is bitten by a species of mosquito, the **anopheles**. The organisms enter the red blood corpuscles, where they grow and develop into similar organisms in 48 or 72 hours, according to the type of organism. At the end of this time, the red blood corpuscles burst, the newly formed malarial parasites and poisonous substances, together with the haemoglobin of the red blood corpuscles, are thrown into the blood.

As a result of the sudden destruction of a large number of red blood corpuscles, and the liberation of poisonous substances, the patient has a chill. The violent muscular contractions which are thus produced, elevate the temperature several degrees, and since this temperature is excessive, it is followed by sweating, which gradually reduces it to normal again. The attacks always occur regularly at about the same time during the day.

These chills, fever and sweats occur every other day, if the organism which causes these symptoms is the **tertian type**, or the one which develops in 48 hours. They occur every third day if the organism is the **quartan type**, the one which develops in 72 hours. In some cases of malaria the chills, fever and sweats occur every day. In these cases the patient is infected with two types of tertian organisms, each one developing every 48 hours, but on alternate days.

Effect of Quinine in Malaria

When given to a patient suffering from malaria, **quinine enters the blood and destroys the plasmodiae**. The chills, fever and sweats are then prevented, and the disease is cured. The use of quinine must be continued for some time, however, even after symptoms have disappeared; until all the plasmodiae in the blood are destroyed, and the patient is free from attacks.

Effect on nutrition and metabolism: Quinine lessens metabolism. It increases the nutrition of the tissues and organs of the body, by preventing the nitrogenous, or protein food from being used up (combining with oxygen). These foods help to build up the patient and conserve the strength. In this way **quinine acts as a tonic**, slightly improving the action of all the tissues and organs of the body and making the patient feel better and stronger.

Action on the blood: Besides its destructive action on malarial parasites, quinine decreases the coagulability of the blood and lessens the number of leucocytes.

Action on the circulation: The pulse is made somewhat stronger and faster, because the contractions of the heart and

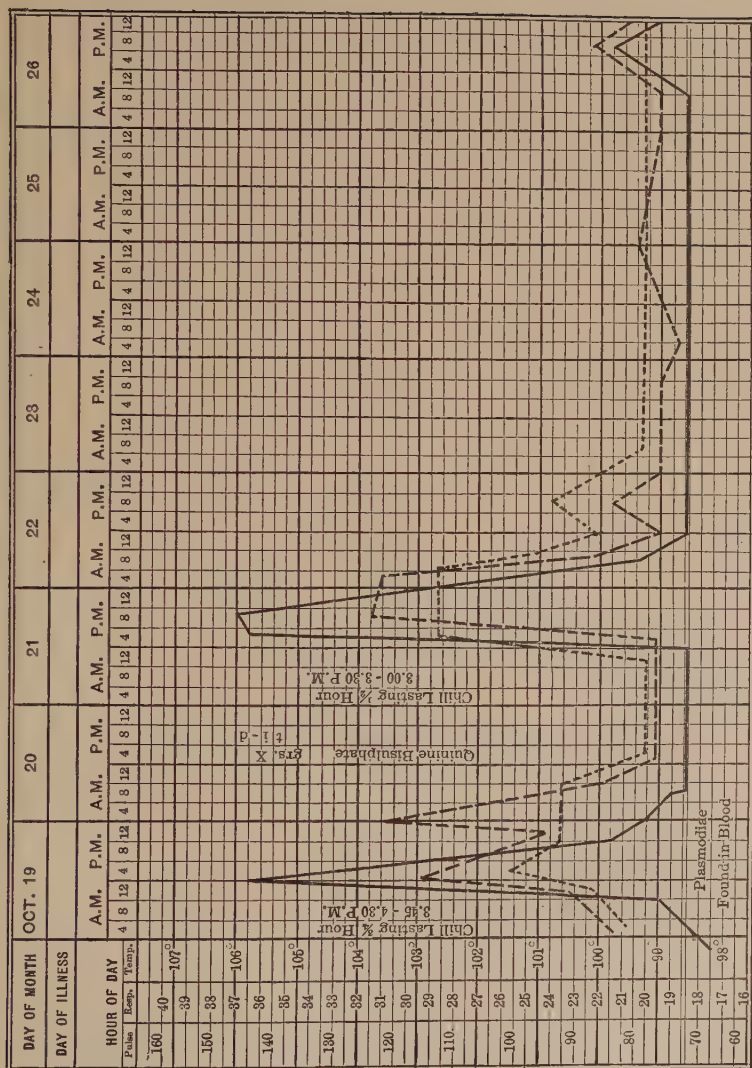


Chart of a case of Tertian Malaria from the Lenox Hill Hospital, showing the effects of quinine on the chills and fever.

blood vessels are increased. Large doses occasionally cause a slow and weak pulse.

Action on the nervous system: Quinine sometimes lessens nervousness and neuralgic pains.

Action on the senses of sight and hearing: Large doses of quinine very frequently cause ringing in the ears and dimness of vision.

Action on the uterus: Quinine increases the contractions of the uterus during labor; it occasionally causes abortion.

Effect on temperature: The temperature is lowered because oxidation of the nitrogenous or protein substances of the tissues is lessened, and less heat is produced.

Action on the Thyroid Gland: Quinine lessens the activity of the thyroid gland by lowering the rate of metabolism. Patients suffering from exophthalmic goiter and hyperthyroidism (excessive secretion of the thyroid gland) can stand very large doses of quinine.

Excretion

Quinine is eliminated from the body in the urine, mostly in about 6 to 8 hours.

Idiosyncrasies

Many individuals are very susceptible to quinine, even small doses causing poisonous effects. In some patients, the following unusual symptoms occur, even from very small doses:

1. Eruptions on the skin, such as areas of redness resembling the scarlet fever rash, hives or urticaria, and occasionally small blisters. (Herpes.)
2. Occasionally, scanty urine, accompanied by pain; or the urine is tinged with blood or haemoglobin.
3. Slow and weak pulse, and a feeling of weakness.

Poisonous Effects

Since quinine is very frequently given in large doses for malaria, poisonous effects are not uncommon. These effects result from continued use of quinine, or from very large doses taken to produce abortion. While the symptoms which result may be alarming, they are rarely, if ever, fatal.

Symptoms

The first and most characteristic symptom of quinine poisoning is:

Ringings in the ears, or roaring sounds in the ears. The patient may become temporarily deaf. The deafness rarely remains permanent.

2. **Dimness of vision**, especially for colors.
3. Temporary blindness or "color blindness." The blindness is occasionally permanent.
4. Nausea and vomiting.
5. Slow, weak pulse.
6. Muscular weakness.
7. Collapse.

Treatment

The symptoms usually subside when the drug is stopped. If they do not disappear, they are usually relieved by bromides. If the pulse is weak, caffeine, given hypodermically, or a hot coffee enema, usually improves it.

Uses

Quinine is used principally in the following conditions:

1. **As a specific in malaria.**
2. As a bitter, to increase the appetite; and as a tonic to improve nutrition.
3. To reduce fever.
4. To destroy the amoebae, unicellular organisms which cause amoebic dysentery, a chronic disease of the intestines. In these cases quinine is usually given by irrigations into the colon or large intestine.
5. To lessen metabolism when the thyroid gland is overactive (hyperthyroidism).

Administration

In malaria, quinine is usually given in one single large dose of 1.0 Gm. (grs. xv) about 4 hours before the time when the chill is expected. It may also be given in divided doses, so that the last dose is given **about the time of the expected chill**. By the time the quinine enters the blood, the parasites are very young and are readily destroyed. It may also be given in divided doses when the temperature is going down, **after the chill**. The administration of quinine should be kept up, however, for about a week after the attack is over, to prevent a recurrence of the symptoms.

1. Quinine is best given in solution after meals, since the presence of acid in the stomach aids the absorption. The addi-

tion of a few drops of dilute sulphuric acid to the fluid in which it is administered usually makes the quinine preparation more soluble, and will aid the absorption.

Quinine is frequently given in the form of powders or pills. The pills are usually not very efficient unless they are fresh. Old quinine pills may pass out in the stools without being absorbed.

2. On account of its unpleasant, bitter taste, quinine is often given in sherry wine, in cachets or capsules, or some food, such as olive oil, may be given afterwards.

3. For its bitter effect it should be given before meals in fluid form, undiluted.

4. In amoebic colitis it is used as an irrigation in 1-2000 to 1-500 solutions.

Preparations

Cinchona

Fluidextract of Cinchona (Fluidextractum Cinchonae)	1.0-4.0 c.c.	m. xv- $\mathfrak{z}$ i
Tincture of Cinchona (Tincture Cinchonae)	4.0-16.0 c.c.	$\mathfrak{z}$ i-iv
Compound Tincture of Cinchona (Tinctura Cinchonae Composita)	2.0-4.0 c.c.	$\mathfrak{z}\frac{1}{2}$ -i

The cinchona preparations are used principally as bitters to increase the appetite. For malaria and as a tonic, quinine preparations are preferable.

Quinine

Quinine (Quinina)	0.3-1.0 Gm.	grs. v-xv
Quinine Bisulphate (Quininae Bisulphas)	0.3-1.0 Gm.	grs. v-xv

This is the most commonly used preparation, since it is the most soluble one.

Quinine Sulphate (Quininae Sulphas)	0.3-1.0 Gm.	grs. v-xv
Quinine Hydrobromide (Quininae Hydrobromidum)	0.3-1.0 Gm.	grs. v-xv

This is frequently used to lessen overactivity of the thyroid gland in exophthalmic goiter.

Quinine Hydrochloride (Quininae Hydrochloridum)	0.3-1.0 Gm.	grs. v-xv
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Other Alkaloids of Cinchona

Quinine and Urea Hydrochloride (Quininae et Ureae Hydrochloridum)	0.3-1.0 Gm.	grs. v-xv
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This preparation is suitable for hypodermic use. It is also used as a local anaesthetic injected hypodermically or applied to mucous membranes.

Quinine Tannate (Quininae Tannas)	0.6-2.0 Gms.	grs. x-xxx
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This preparation is slowly absorbed, and has no bitter taste. It is often made into chocolates for children.

Other Alkaloids of Cinchona

Quinidine Sulphate (Quinidine Sulphas)	0.2-0.4 Gm.	grs. iii-vi
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This is used principally to slow and regulate rapid heart action. (See page 223).

Cinchonine Sulphate (Cinchoninae Sulphas)	0.5-1.3 Gm.	grs. viii-xx
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Cinchonidine Sulphate (Cinchonidinae Sulphas)	0.5-1.3 Gm.	grs. viii-xx
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Compound Preparations

Iron and Quinine Citrate (Ferri et Quininae Citras)	0.3-0.6 Gm.	grs. v-x
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Syrup of Iron, Quinine and Strychnine Phosphate (Syrupus Ferri, Quininae et Strychninae Phosphatum)	4.0 c.c.	℥i
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Elixir of Iron, Quinine and Strychnine Phosphate (Elixir Ferri, Quininae et Strychninae Phosphatum)	4.0 c.c.	℥i
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Warburg's Tincture

This is a dark brown liquid which is used extensively in India, in the treatment of malaria. It contains a large number of ingredients besides quinine, such as aloes, rhubarb, gentian, camphor, etc.

New and Non-official Preparations

Aristochin	0.3-1.0 Gm.	grs. v-xv
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This is a chemical derivative of quinine. It is not so apt to cause poisonous symptoms.

Euquinine (Quininae Aethylcarbonas)	0.3-1.0 Gm.	grs. v-xv
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This is a tasteless chemical derivative of quinine.

Chinaphenin	0.3-0.6 Gm.	grs. v-x
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This is a compound of quinine and phenacetine. It combines the quinine action with the anodyne effect of phenacetine. It is tasteless and is not apt to cause poisonous symptoms.

Quinine Lygosinate (Quininae Lygosinas)

This is a chemical derivative of quinine. It is used as an antiseptic dusting powder, or in solution to check bleeding.

Saloquinine	0.5-2.0 Gms.	grs. viii-xxx
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This combines the action of quinine with salicylic acid.

Saloquinine Salicylate 1.0 Gm. grs. xv

Ethylhydrocupreine hydrochloride (Optochin or Numoquin)
(Ethylhydrocupreinae hydrochloridum)

This is a substance which comes in a neutral form or as a base obtained from the Cuprea bark, the bark of a Chinese plant. It is also made from hydroquinine, a substance made from quinine. It acts like quinine and has a specific destructive action on pneumococci, the bacteria which cause pneumonia. It has therefore been used as a specific for pneumonia.

The treatment is begun by giving 0.5 Gm. (grs. viii) as an initial dose, followed by 0.15 Gm. (gr. ii½) every 3 hours until 1.5 Gms. (grs. xxiii) has been given in twenty-four hours. The best results are obtained when the drug is given early in the disease as otherwise the pneumococci become resistant to it. It is also given hypodermically in solution, or in oil.

It is applied locally in 1% solutions to local infections caused by the pneumococci, such as certain forms of ulcers of the cornea of the eye.

Ethylhydrocupreine is particularly apt to cause poisonous symptoms, which are those of quinine poisoning. It is especially apt to cause eye symptoms, even blindness.

PHLORIDZIN

Phloridzin is a glucoside obtained from the roots of the apple, pear, cherry, and other trees.

It is occasionally used to destroy malarial parasites. It forms sugar in urine and increases its secretion. Because of its irritating effect on the kidneys, it is rarely used, except to test the action of the kidneys.

Phloridzin 0.3-0.6 Gm. grs. v-x
(Phloridizinum)

Maturin

This is a preparation of phloridzin which is injected hypodermically as a test for pregnancy before other signs are present. If the patient is pregnant sugar will appear in the urine after the injection.

METHYLENE BLUE

This is a blue dye which is occasionally used as a specific for malaria.

MERCURY (HYDRARGYRUM)

Mercury or quicksilver is a silver-colored liquid metal which evaporates very easily. Many of its salts are used in medicine.

Appearance of the Patient

A few hours after giving an average dose of a preparation of mercury, the patient usually has several movements of the bowels and more urine is passed. The stools are soft, colored with bile, and accompanied by a little griping. Occasionally the flow of saliva is also slightly increased.

If small doses of mercury preparations are given continuously for weeks or longer, to a patient suffering from the first or second stage of syphilis, the symptoms, such as the original ulcer or chancre, the rash on the body, the mucous patches in the mouth, and the swelling of the glands, all gradually disappear.

ACTION

The salts of mercury combine with the proteins and albumins of all living matter, forming an albuminate of mercury. It is therefore irritating to, and may even destroy, living cells. In this way, it checks the growth of bacteria (antiseptic action), and other living organisms and parasites (antiparasiticide).

Local action: applied to the skin, mercury preparations are excellent antiseptics. If a strong solution is used, or even a weak solution continuously, redness, pain and itching of the skin will result. If a strong solution is kept in contact with the skin for a long time, inflammation and even destruction of the skin may result.

Internal Action

In the stomach: They slightly increase the secretions, occasionally causing nausea and vomiting.

In the intestines: Mercury preparations increase the secretions and peristalsis, **causing frequent soft stools stained with bile.** They also act as intestinal antiseptics. The large quantity of bile in the stools which results from preparations such as calomel, is due to the antiseptic action, which prevents the decomposition of the bile, and to the increased peristalsis of the bile ducts which accelerates its flow.

Action with Absorption

Mercury salts are readily absorbed into the blood from all the mucous membranes, from the lungs, and even from the skin. When given by mouth, they are absorbed in 1 to 2 hours. After absorption, they affect principally the intestines, the kidneys, some of the secretions, the nutrition of the tissues, and if given steadily, they act as a specific for syphilis, especially in the first and second stages of the disease.

Action on the kidneys: Mercury salts increase the flow of urine.

Action on the secretory glands: All the secretions, especially the saliva and pancreatic juice, **are increased.**

Action on nutrition: Small doses of mercury preparations, if given for some time, increase the nutrition of the tissues, and the body weight (alterative action).

Specific Action in Syphilis

Syphilis

Syphilis is a chronic infectious disease, caused by the **Spirochaeta pallida**, a spiral-shaped organism. The infection begins with the formation of a hard ulcer, or **chancre**, usually on the genital organs. This is known as the first stage of the disease. It is followed in about six weeks by an eruption all over the body (**roseola**), whitish patches in the mouth (**mucous patches**), and **swelling of all the lymph glands** throughout the body. This is known as the second stage of the disease. Some time later, in several months or years, or at any time during the patient's lifetime, various diseases may develop due to the formation of **gummata**. These are areas of round cells which readily decompose, forming a thick fluid in the center. Gummata may occur in any organ of the body and produce many and varied symptoms, depending on the organs in which the destructive changes take place. This is known as the third stage of the disease.

Parents infected with syphilis may transmit the disease to their children. The children may be born dead, or if they live, they may suffer, at any time during their childhood, from various symptoms which are characteristic of the third stage of the disease, in the acquired form.

Effect of Mercury

Mercury preparations, if given steadily to a patient suffering from the first or second stage of syphilis, **usually relieve all the symptoms in a very short time**. The rash and the mucous patches soon disappear, the glands become smaller, until they, too, finally disappear. This curative action of mercury in syphilis is probably due to the destruction of the *Spirochaeta pallida*, the organism which causes the disease.

Excretion

Mercury preparations are excreted mainly by the kidneys and the intestines, and also slightly, by all the secretions, such as saliva, milk, bile, gastric juice, etc. They are very slowly eliminated from the body, usually in one or two days. Some of the mercury often remains in the body for a long time afterwards, and may then be gradually excreted.

Poisonous Effects

Mercury poisoning occurs in two forms: acute poisoning and chronic poisoning.

Acute Mercury Poisoning

Acute mercury poisoning usually results from swallowing bichloride of mercury in tablet form or in solution either by accident or with suicidal intent. Frequently the use of strong bichloride of mercury douches causes poisoning symptoms.

Symptoms

1. Metallic taste in the mouth, and burning pain in the throat.
2. Cramp-like, abdominal pains.
3. Nausea and vomiting; the vomited matter contains bile and later blood.
4. Diarrhoea with bloody stools.
5. Scanty urine which may contain albumin or blood.
6. Collapse, as a result of the profuse vomiting and diarrhoea; rapid, weak, irregular pulse, the face is pinched and anxious, the skin is cold and moist, the breathing slow and shallow.
7. Convulsions and coma may occur before death.

Usually the patient lives several days or weeks; then develops a very severe acute nephritis characterized by scanty, bloody urine, which contains albumin. Finally uraemia with convulsions and coma develop, from which the patient may die.

Death from mercury poisoning usually occurs in one to seven days.

If death does not occur, recovery takes place very gradually, the symptoms of the nephritis persist and the patient develops salivation, soreness of the gums or gangrenous ulcers in the mouth, throat, jaws, palate or cheeks, which last for a long time.

When the poisoning results from vaginal douches, the nausea and vomiting are absent, but the patient suffers principally from diarrhoea with serous or bloody stools which last for weeks, followed by gradually developing soreness of the gums and ulceration of the jaw.

Treatment

1. **The antidote for mercury poisoning is white of egg, milk or flour.** These substances contain albumins, which combine with the mercury, forming an albuminate of mercury, and thus prevent the poisonous effects. About one egg should be given for every 4 grains of bichloride of mercury or other preparation taken.

2. Opium or morphine is given to check the diarrhoea, and to keep the patient quiet.

3. The collapse is treated with heart stimulants such as caffeine, atropine, strychnine, etc.

4. The nephritis is treated by a low protein diet and by the usual medical procedures for this disease.

"Mercurialism"

Mercurialism is a very common condition which results from prolonged use of mercury preparations. Syphilitic patients can often take large doses of mercury without developing any poisonous effects.

Symptoms

The following are the symptoms of excessive mercury action:

1. **Profuse flow of saliva**, and a metallic taste in the mouth. This is soon followed by:

2. **Soreness and bleeding of the gums**, later ulcerations of the gums, mouth or throat, loosening of the teeth, and even destruction of the bones of the jaw. The breath has a very foul odor from the destroyed tissue.

3. **Diarrhoea**, often with bloody stools.

4. **Anaemia**.

5. **Loss of weight**.

6. **Scanty urine**.

7. **Paralysis of the hands or feet** with "drop-wrists" or "drop-feet," may occasionally result.

Treatment

1. **Stop the administration of mercury**.

2. The soreness of the gums is best relieved by a potassium chlorate mouth wash or a tannic acid mouth wash. The gums are often painted with tincture of myrrh.

3. The diarrhoea is best checked by opium.

Uses

Mercury preparations are used principally:

1. As a specific for syphilis, principally for the first and second stages.

2. Many of the preparations are excellent antiseptics.

3. Some of the preparations are excellent purgatives.

4. Mercury is said to have a very beneficial effect in relieving acute infections of the serous membranes, such as pleurisy or peritonitis. It also reduces enlargements of lymph glands.

5. As a diuretic.

Administration

1. Mercury is occasionally given by mouth but it is now principally given by **deep injections into the muscles**. The preparation is usually injected into the muscles of the buttocks, which are then rubbed very thoroughly to hasten the absorption.

2. For absorption from the skin, mercury is applied by "**rubblings**" or **inunctions** in the form of an ointment. The ointment is thoroughly rubbed on the skin for six days, every day on a different region of the body; thus, one day on the arms, another day on the forearms, the thighs, the legs, the back, etc. On the seventh day the patient is given a bath to remove the ointment from the skin; and then the course is begun again.

In giving mercury inunctions, the nurse should protect her hands with leather gloves, as otherwise she herself may absorb the drug, and develop poisonous effects.

Mercury is also given for absorption by the skin, in the form of vapor. The patient sits in a closed cabinet over a **lamp containing burning calomel**. The fumes thus generated are absorbed by the skin. Some mercury preparations are frequently given **by mouth**.

Preparations

Bichloride of mercury is used as an antiseptic (see page 57). It is occasionally given by mouth in 0.0012–0.006 Gm. (gr. $\frac{1}{50}$ – $\frac{1}{10}$) doses.

Calomel, Blue Mass and Mercury with Chalk are used as purgatives (see page 168).

Yellow Iodide of Mercury	0.008–0.06 Gm.	gr. $\frac{1}{8}$ –i
Protoiodide of Mercury (Hydrargyri Iodidum Flavum)		
Red Iodide of Mercury	0.0012–0.006 Gm.	gr. $\frac{1}{50}$ – $\frac{1}{10}$
Biniodide of Mercury (Hydrargyri Iodidum Rubrum)		
Solution of Arsenic and Mercuric Iodides	0.06–0.3 c.c.	m. i–v
(Liquor Arseni et Hydrargyri Iodidi) (Donovan's Solution)		

This contains 1% each of arsenic iodide and the red mercuric iodide.

For Local Use

Mercurial Ointment (Blue Ointment) (Stronger Mercurial Ointment)
(**Unguentum Hydrargyri Fortius**)

This is made by thoroughly rubbing together mercury, oleate of mercury, lard and suet. It is used principally for inunctions.

Ointment of Yellow Mercuric Oxide
(**Unguentum Hydrargyri Oxidi Flavi**)

This now contains 1% of yellow oxide of mercury, formerly 10%.

Ointment of Red Mercuric Oxide
(Unguentum Hydrargyri Oxidi Rubri)

This contains 10% of red oxide of mercury.

Ointment of Ammoniated Mercury
(Unguentum Hydrargyri Ammoniaci)

This contains 10% of ammoniated mercury.

Ointment of Mercuric Nitrate (Citrine Ointment)
(Unguentum Hydrargyri Nitratis)

This contains 7% of mercuric nitrate.

Black Wash
(Lotio Hydrargyri Nigra)

This consists of 4.0 Gms. (3i) of calomel to 500 c.c. (1 pt.) of lime water. It is used principally as an external application.

Yellow Wash
(Lotio Hydrargyri Flavi)

This consists of corrosive sublimate 2.0 Gms. (3½) to 500 c.c. (1 pt.) of lime water. It is used principally as a local application.

Mercuric Salicylate	0.003-0.008 Gm.	gr. $\frac{1}{20}$ - $\frac{1}{8}$
(Hydrargyri Salicylas)		

For intramuscular use	0.06 Gm.	gr. i
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This preparation contains 54 to 59% of mercury and is commonly used, especially for intramuscular injections. For these injections, a 10% solution in water or liquid paraffin is used, of which 0.6 c.c. (m. x) is injected deep into the gluteal muscles every fourth day.

New and Non-official Preparations

Mercuric Succinimide	0.01-0.015 Gm.	gr. $\frac{1}{8}$ - $\frac{1}{4}$
(Hydrargyri Succinimidum)		

This is used principally for intramuscular injections but it is not irritating. A 2½% solution is used, of which 0.5-1.0 c.c. (m. viii-xv) are injected daily.

It also comes in hypodermic tablets, each containing 0.006-0.003 (gr. $\frac{1}{10}$ - $\frac{1}{20}$).

Mercuriol	0.03-0.12 Gm.	grs. $\frac{1}{2}$ - ii
(Hydrargyri Nucleinas)		

This is a compound of mercury with nucleic acid, an acid contained in yeast. It is said to have a special value as an antiseptic and specific for syphilis.

Mergal	one capsule	0.015 Gm.	gr. $\frac{1}{4}$
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This is a mixture of mercuric cholate and albumin tannate put up in capsules. Each capsule contains 0.05 Gm. (gr. $\frac{3}{4}$) of mercuric cholate.

Mercuric Benzoate	0.015-0.03 Gm.	gr. $\frac{1}{4}$ - $\frac{1}{2}$
(Hydrargyri Benzoas)		

This has been used principally as a specific for syphilis and is given hypodermically in 1 to 2½% solutions.

Mercury Cacodylate 0.03 Gm. gr. ½
Hydrargyri Cacodylas

This is a compound of mercury and cacodylic acid, an arsenic compound which comes in ampoules. It is given intramuscularly for syphilis.

Bichloridol 0.015–0.12 Gm. grs. ¼–ii

This is a mixture of bichloride of mercury with a fat, palmitin. It is slowly absorbed and therefore does not produce poisonous symptoms readily. It comes in a large gelatine "collapsule." It is given intramuscularly and intravenously.

Mercurosol 0.05–0.1 Gm. grs. ⅝–i½

This is a compound of mercuric acetate and silcylacetic acid, used principally for syphilis. It is not as poisonous as bichloride of mercury. It comes in large gelatine capsules. It is given intramuscularly and intravenously.

Calomelol

Cololidal Calomel

(**Hydrargyri Chloridum Mite Colloidale**)

Calomelol is a preparation of calomel combined with albuminoids, and is said to act more efficiently, not to gripe as much, and to be less poisonous than calomel. It is used as a dusting powder and as an ointment.

Mercurialized Serum

This is a solution of bichloride of mercury in normal horse serum diluted with physiological salt solution. It is used in the treatment of syphilis of the nervous system and is given by direct injection into the spine in doses of 30 c.c. after the removal of a similar quantity of fluid from the spine. This contains bichloride of mercury gr. $\frac{1}{50}$, which may be increased to gr. $\frac{1}{25}$. It is also given intravenously in 2 c.c. of normal salt solution containing gr. $\frac{1}{12}$ of bichloride of mercury.

THE IODIDES

The iodides are salts formed by the action of an alkali, such as sodium, potassium or ammonium, on hydriodic acid, an acid formed from iodine; which is a non-metallic element, obtained from sea-weeds.

Appearance of the Patient

After a single dose of one of the iodide salts is given, except for its slightly metallic salty taste, a slight burning pain in the stomach, and perhaps some slight nausea for a few minutes, there are no appreciable effects.

If the iodides are given continuously for some time, however, the secretions are all increased, the pulse is somewhat faster and softer, the patient passes more urine and feels much better.

Prolonged administration of the iodides to a patient suffering from any manifestation of **syphilis**, especially any symptoms of **the third stage**, causes a gradual disappearance of these symptoms, and in a very short time the patient feels entirely well again. For example, if the patient has a syphilitic ulcer in any region of the body, the ulcer gradually heals. A syphilitic paralysis when treated with an iodide preparation, soon disappears, and the patient can move the paralyzed extremity perfectly well again.

ACTION

Internal Action

In the mouth : The iodides have a characteristic salty metallic taste.

In the stomach : They slightly increase the secretions, and occasionally cause nausea, and slight discomfort. The intestines are not usually affected by the iodides.

Action after Absorption

The iodides are very rapidly absorbed into the blood; from the stomach, intestines, and from all the mucous membranes, usually in about five minutes. After absorption, they act principally as a specific for syphilis. They also affect the secretions, the thyroid gland, newly formed tissues, the nutrition, and slightly the kidneys.

Specific Action in Syphilis

The most striking effect of the iodides is noticed in patients suffering from syphilis, especially from the symptoms of the third stage. These symptoms are the result of the formation of areas of round cells (gummata) in various parts of the body due to the presence in the blood of the *Spirochaeta pallida*. These newly formed areas of cells become fluid, and areas in some tissues and organs of the body are thus destroyed, producing various symptoms.

Very soon after the treatment with the iodides is begun in such cases, the patient feels better, the particular manifestation of syphilis from which he may be suffering begins to improve, until finally he may be entirely well again. For example, if the patient is suffering from a syphilitic ulcer in any part of the body, this ulcer heals very rapidly after treatment with iodides.

A syphilitic paralysis due to the formation of a gumma in the brain or spinal cord, when treated with iodides, soon disappears. The affected extremities regain their motion and the patient soon

feels entirely well again. In a similar manner, a syphilitic condition of any organ of the body is cured.

The iodides cure the third stage of syphilis, by causing the absorption of newly formed areas of round cells, or gummata, which cause the various symptoms. They probably destroy the spirochaetae which cause the disease. They are also specifics for other infections such as actinomycosis and sporotrichosis.

Action on the secretions: The iodides increase the secretions of all the mucous membranes and the secretory glands. The mucus from the nose and bronchi is increased, and becomes more fluid in character. The secretion of saliva, of milk, and the secretions of the other glands are also slightly increased.

Action on the Thyroid Gland: Iodine is a normal constituent of the thyroid gland and is necessary for the formation of its secretion. By providing this gland with more iodine its secretions are increased. As a result, it makes the pulse somewhat more rapid, and causes a loss in weight. Goiter, a form of enlargement of the thyroid gland which occurs in certain mountainous and inland countries, is believed to be due to deficiency of iodine in the drinking water.

Continued use of iodine or iodide preparations often reduces goiters.

Action on nutrition: The iodides increase the nutrition of the tissues and hasten the excretion of waste products. The effect is probably due to the increased secretion of the thyroid gland.

Effect on newly formed connective tissues: The iodides increase the absorption of newly formed connective tissue. They are used to absorb old scar tissue in any organ of the body. They are frequently used for this effect in arteriosclerosis (hardening of the arteries), cirrhosis of the liver, etc.

Newly formed connective tissue cells are small round cells which resemble the round cells found in gummata. These cells may therefore be affected by the iodides in the same way as the gummata or round cell formations of the third stage of syphilis, or as a result of the increased secretion of the thyroid gland.

Accumulations of serum in the chest (pleurisy with effusion) or in other parts of the body, are more rapidly absorbed when iodides are given.

Action on the circulation: Iodides do not usually affect the pulse. They occasionally make the pulse somewhat more rapid and they are used to lower blood pressure but not effectively

The effect may be due to the increase in the secretion of the thyroid gland.

Excretion

The iodides are eliminated from the body in the urine, mainly as iodides, usually within twenty-four hours. In the body, the iodine is separated from the iodide salts, which is then excreted in all the secretions of the secretory glands and mucous membranes. The mucus of the nose and the bronchi, the saliva, the milk, the hair, all contain iodine.

Idiosyncrasies

In some individuals small doses of the iodides often cause poisonous effects.

Poisonous Effects

The iodides do not cause acute poisoning. Since they are excreted more slowly than they are absorbed, after prolonged administration, chronic poisoning or **iodism** frequently results from the accumulation of some of the drug in the body. These cumulative symptoms occasionally occur in some individuals from very small doses.

The symptoms of iodism are due to the excretion of the iodine by the various mucous membranes. They are not so apt to occur in syphilitic patients.

Cumulative Symptoms or "Iodism"

The first symptom of excessive iodide action is:

Profuse secretion of mucus from the nose (coryza) and sneezing, which is soon followed by:

2. Red, swollen eyelids with excessive flow of tears.
3. **Frontal headache.**
4. Cough, with profuse expectoration of mucus.
5. Increased flow of saliva.
6. **Skin eruptions**, such as areas of redness, or small pustules on the face, back, shoulders or thigh (acne). Occasionally eczema occurs.
7. The pulse is often rapid and a slight rise in temperature may occur.
8. Nausea and diarrhoea occasionally occur.
9. Weakness, loss of weight, and pains in the joints occasionally result from continued use.

Treatment

When the iodides are stopped, the symptoms usually disappear.

Uses

The iodides are used principally for the following conditions:

As a specific for the third stage of syphilis. In syphilis, the treatment must be continued for about three years, even if the patient has no symptoms, otherwise recurrence of symptoms or new syphilitic manifestations may occur.

2. To absorb connective tissue in chronic diseases characterized by the formation of connective tissue in various organs and tissues of the body. For example, in **arteriosclerosis** (thickening of the blood vessels by the formation of connective tissue in their walls), **cirrhosis of the liver**, or the formation of connective tissue in the liver, **chronic nephritis** or the formation of connective tissue in the kidneys, etc.

3. To increase the absorption of inflammatory swellings of the glands and other tissues, and to absorb fluids in the chest.

4. To increase the secretions of the mucous membranes, such as those of the bronchi, the nose, etc.

5. Iodine preparations are used in the treatment of goiter, especially in districts where goiter is prevalent. They are given in the form of an iodine salt, iodized chocolate and standard preparations such as Lugol's solution. The latter preparation is also used in the treatment of Exophthalmic goiter.

Administration

The iodides are best given after meals, in milk, wine, aromatic spirit of ammonia, or the compound spirit of sarsaparilla, or cinnamon water, to disguise the unpleasant taste. It is occasionally given in pills or capsules.

Preparations

Potassium Iodide	0.3-1.0 Gm.	grs. v-xv
(Potassii Iodidum)	In syphilis it may be given up to 4.0 Gms. (3i).	

This is the most efficient and most commonly used preparation. It comes in a 50% or a saturated (100%) solution.

Sodium Iodide	0.12-1.3 Gm.	grs. ii-xx
(Sodii Iodidum)		

Ammonium Iodide	0.12-1.0 Gm.	grs. ii-xv
(Ammonii Iodidum)		

Strontium Iodide	0.3-1.0 Gm.	grs. v-xv
(Strontii Iodidum)		

Dilute Hydriodic Acid 0.3-0.6 c.c. m. v-x
(*Acidum Hydriodicum Dilutum*)

This contains 10% of hydriodic acid.

Syrup of Hydriodic Acid 2.0-8.0 c.c. $5\frac{1}{2}$ -ii
(*Syrupus Acidi Hydriodici*)

This contains 1% of hydriodic acid.

Compound Iodine Solution (Lugol's Solution) 0.2-0.8 c.c. m. iii-xii
(*Liquor Iodi Compositus*)

This contains 5% of iodine dissolved in a 10% potassium iodide solution. It is used in the treatment and prevention of goiter and in the treatment of Exophthalmic goiter. It is often given in larger doses than above (as much as 3.0 c.c. (m. xlv)).

Calcium Iodide 0.6 Gm. grs. x
(*Calcii Iodidum*)

This comes in 5 c.c. ampoules for intravenous use.

Calcium and Mercuric Iodide

This comes in 20 c.c. ampoules for intravenous use, each ampoule containing calcium iodide 0.6 Gm. (grs. x) and mercuric iodide 0.015 Gm. (gr. $\frac{1}{4}$.)

Iodized Fats

The following preparations consist of combinations of the iodides with various fats. These are digested in the intestines and the iodine is absorbed and deposited in the fat tissues where it is gradually given off to the body. Slow absorption is thus produced and toxic symptoms are not so apt to occur.

Sajodin or Calioben 1.0-3.0 Gms. grs. xv-xlv
Calcium Monoiodobehenate

Ferro Sajodin or Ferioben

This contains 24% of iodine and 5% of iron. It comes in tablets, each containing 0.5 Gm. (grs. viii). It is given in doses of 1-2 tablets.

Riodine 0.4-1.2 Gm. grs. vi-xviii

This is a 66% solution in oil, of an iodine preparation of castor oil which contains 17% of iodine. It comes in capsules, each containing 0.2 Gm. (grs. iii).

Iodipin 0.2-0.6 Gm. grs. iii-x

This is a compound of iodine and sesame oil. It is given hypodermically from a 10-25% solution or in capsules.

Iodized Poppyseed Oil

Dubois' Iodoleine

This is a combination of poppyseed oil and iodine. It contains about 26% iodine. It is warmed and injected intramuscularly. It also comes in capsules and ampoules.

Lipoiodine

This is a complex organic iodine salt containing a complex iodine fatty

substance containing 41% of iodine. This comes in tablets, each containing 0.3 Gm. (grs. v).

Iodostarine

This contains 47½% of iodine and is prepared by combining iodine with tariric acid, a substance obtained from a certain fruit. The dose is from 0.3–2.0 Gms. (grs. xx). It also comes in chocolate tablets. It is used to prevent and to reduce goiter in regions where it is prevalent.

Protein Preparations

Casein Iodine (Iodocasein) 0.3–1.3 Gms. grs. v–xx

This is a compound of iodine with milk casein. It is quickly digested in the intestinal tract, liberating iodides.

Iodalbin 0.3–0.6 Gm. grs. v–x

This is a compound of iodine and the albumin obtained from blood. It contains 21½% of iodine. It is digested in the intestines, from which the iodine is absorbed.

Other Preparations

Calcidin 0.02–0.06 Gm. gr. ⅓–i

This contains 15% of available iodine, calcium and starch. It is used to prevent goiter in goitrous districts. It is also combined with licorice as a cough medicine.

Siomine or Hexamethylenamine Tetraiodine

This is a complex chemical substance containing 78½% of iodine. It is separated into urotropine and iodide. It may cause irritation of the bladder and bloody urine, due to the urotropine.

For Local Use

Potassium Iodide Ointment
(Unguentum Potassii Iodidi)

Iothion or Iopropane

This is a complex chemical substance containing 77–80% of iodine. It is readily absorbed from the skin and is used as local applications on the skin in 25–50% ointments.

SALVARSAN OR ARSPHENAMINE

Salvarsan, arsphenamine, arsenobenzol, or “606” is a complex organic arsenic salt. It is a yellow powder which comes in a sealed glass tube together with nitrogen gas, since it is readily changed by the oxygen of the air.

ACTION

Salvarsan is a specific for all stages of syphilis. It combines with, and destroys, the *Spirochaeta pallida*, the organism which causes the disease. In a few weeks after the administration of

the remedy, there is a remarkable and prompt disappearance of all the symptoms of the disease, such as the initial sore, the rash, the mucous patches and the other manifestations. The patient is not considered cured, however, until the examination of his blood shows that he is free from the disease. The administration of the remedy is therefore repeated at weekly intervals.

Salvarsan is used in conjunction with, or followed by, the usual two-year course of treatment with mercury and iodides.

The symptoms of the third stage of syphilis frequently return as long as twenty years after the original infection. The patient should therefore be observed at frequent intervals after he is apparently cured and his blood tested. If any symptoms, or the blood test indicate the presence of syphilis, the treatment should be started again.

Salvarsan has also been used with success in the treatment of malaria and other infectious diseases resulting from the circulation in the blood of parasitic organisms, such as those of relapsing fever, frambesia, etc. It has also been used in chorea (St. Vitus' dance).

Idiosyncrasies

1. Symptoms of arsenic poisoning may result.
2. The rash may temporarily become more intense, there may be a rise in temperature, headache and ringing in the ears (Hexheimer's reaction).

Administration

Salvarsan is usually given by direct injection into the veins.

The ampoule containing the salvarsan is wiped off with alcohol and the neck is filed and broken off. The powder is then put into a sterile glass-stoppered bottle. Sterile distilled water is now added and the powder is dissolved by shaking the bottle. A few drops of a 15% sodium hydroxide solution is then added drop by drop, until the fluid becomes cloudy. When a few drops more are added, the cloudiness clears up. It is usually necessary to add about 3 or 4 drops of the sodium hydroxide solution for every 0.1 Gm. of salvarsan. The mixture is then diluted by adding about 30 c.c. of sterile water for each 0.1 Gm. of salvarsan used. The salvarsan solution is now ready for administration and is poured into a glass apparatus and allowed to run into the vein very slowly through a rubber tube and intravenous needle. Some physicians prefer to inject salvarsan into the veins with a large syringe using much smaller quantities of fluid. Salvarsan is also given by deep injections into the muscles.

Neosalvarsan is dissolved in sterile, distilled water, about 25 c.c. being used for every 0.1 Gm. of the drug.

It is given like salvarsan, by injection into the veins (intravenously), or into the muscles (intramuscularly).

Neosalvarsan is only half as strong as salvarsan. It is given in larger doses and does not have to be neutralized with an alkali.

Both salvarsan and neosalvarsan are sometimes given by rectum in suppositories.

Swift Ellis Method

This method consists of injecting into the spinal canal the serum of the patient after he has received a salvarsan injection into the veins. Such prepared serum is given in cases of syphilis of the brain and spinal cord. A dose of salvarsan is injected into the vein and an hour later 40 c.c. of blood is withdrawn from the vein. This is allowed to clot and is then placed on ice for twenty-four hours. When the blood has clotted entirely the serum is removed with a pipette. A 40% solution is then made of this serum by adding 12 c.c. of the serum to 18 c.c. of normal salt solution. The solution is now heated for about half an hour to a temperature of about 50° C. and is then injected into the spinal canal after removing the same quantity of fluid.

Preparations

Arsphenamine or Salvarsan	"606"	0.3-0.6 Gm.	grs. v-x
Arsphenolamine hydrochloride			

This contains about 31% of arsenic.

Neosalvarsan or Neoarsphenamine	0.6-0.9 Gm.	grs. x-xiv
Sodium Salvarsan or Sodium Arsphenamine		

This is a preparation which does not have to be neutralized with an alkali.

Silver Salvarsan or Silver Arsphenamine	0.1-0.3 Gm.	grs. i½-v
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This is a combination of silver and arsphenamine containing 20% arsenic and 15% silver. It is believed to be a better preparation than salvarsan, since it combines the silver and the arsenic. In overdoses it may cause poisonous symptoms, such as swelling and a dark color of the skin, due to the silver (argyria). It is given dissolved in 5 c.c. of warm distilled water.

Sulphur Arsenol or Sulpharsphenamine	0.06-0.6 Gm.	gr. i-x
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This is a compound of sulphur and arsphenamine which contains 19-24% of arsenic. It is about 1½ times as strong as arsphenamine, but is slowly absorbed; it does not cause poisonous symptoms and does not decompose when exposed to air. It may be given hypodermically as well as intramuscularly and intravenously.

Salvarsan is made by different firms under the following names.

Arsaminol

Arsenobenzol

Diarsenol

Arsphenolamine S (Neosalvarsan)

SODIUM THIOSULPHATE

This is a substance which is used for the symptoms of arsenic poisoning following the injection of salvarsan, and especially for the swelling of the skin. It is used for other skin diseases, such as poison ivy, dermatitis, etc. It comes in ampoules containing 0.6, 0.75 or 1.0 Gm., and is given intravenously.

BISMUTH PREPARATIONS

Bismuth compounds have recently been used in the treatment of syphilis with fairly good results. The effects are somewhat better than mercury but not as good as salvarsan. The treatment is usually given in conjunction with salvarsan or mercury, or when these remedies fail or when patients cannot tolerate them. Poisonous effects similar to mercury poisoning may occur. The preparations of bismuth tartarate are principally used and are given intramuscularly.

Preparations

Potassium Bismuth Tartarate	0.1-0.2 Gm.	grs. $i\frac{1}{2}$ -iii
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This comes in ampoules for intramuscular use.

Bismudol	0.2 Gm.	grs. iii
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This is phenyl formitate of bismuth, which comes in "collapsules" for intramuscular injection.

SALICYLIC ACID AND THE SALICYLATES

Salicylic acid is a white crystalline powder which is made chemically by the action of sodium hydroxide (caustic soda) and carbonic acid, on carbolic acid.

The **salicylates** are salts formed by the combination of an alkali with salicylic acid. For example, sodium salicylate is formed when salicylic acid is combined with sodium. Various other salts are made in a similar way. **Methyl salicylate** is formed by the combination of an organic chemical substance, such as methyl alcohol, with salicylic acid.

Many salicylates are found in various plants. For example, methyl salicylate is found in the oil of **wintergreen** or **oleum gaultheriae**, and in the oil of **sweet birch**, **oleum betulae**.

There are many new artificial preparations made chemically from salicylic acid or its salts, some of which, such as aspirin, are extensively used.

Appearance of the Patient

About 15 minutes after an average dose of salicylic acid, or one of the salicylates is given, the patient complains of a slight burning pain in the region of the stomach, and possibly of a slight feeling of fullness in the head. Soon he sweats profusely, and the temperature is lowered 1 or 2 degrees, particularly if there is fever. The pulse may be somewhat faster and stronger, unless a large dose has been given, when it may be slightly slower and weaker. The breathing is usually somewhat more rapid, and the patient passes more urine.

If the patient is suffering from acute articular rheumatism, the pains and swellings around the joints are gradually relieved.

ACTION

Local action: Salicylic acid and the salicylates are antiseptics. They also soften the epidermis or hard layer of the skin, when directly applied.

Internal Action

In the mouth: They have a peculiar salty sour taste.

In the stomach: Salicylic acid and the salicylates increase the secretions. If given when the stomach is empty, they are apt to cause burning pain in the stomach, occasionally nausea, and possibly vomiting.

In the intestines: They have an antiseptic action, checking the growth of bacteria.

Action after Absorption

Salicylic acid and the salicylates are rapidly absorbed from the stomach and intestines, usually in about 15 minutes. After absorption, they affect the temperature, the sweat glands, the circulation, the respiration and the kidneys. They affect especially acute articular rheumatism.

Specific Action in Rheumatism

Salicylic acid and the salicylates are used principally as specifics for acute articular rheumatism.

Acute articular rheumatism is a disease characterized by pain, redness and swelling of the various joints of the body, associated with high temperature. The disease begins in one joint, and then affects many of the others, often involving one joint after another. Its cause is unknown, though it is probably an infectious disease.

Effect of Salicylates

When any of the salicylates are given regularly for some time, to a patient suffering from acute articular rheumatism, the pains become lessened in a few days, the redness and swelling of the joints are diminished, the temperature subsides, and the patient soon gets well.

The mode of action is probably due to the excretion of salicylic acid into the joints and thus affecting the causative agent of the disease. Many cases are improved by some preparations of the salicylates more than by others. Other cases are not improved at all by any of them. Chronic rheumatism does not respond so readily to treatment with the salicylates.

Effect on temperature: The salicylates reduce the temperature several degrees, in fevers, because of the increased elimination of heat which results from the profuse sweating and dilated blood vessels of the skin. The temperature begins to go down in fifteen minutes, and stays down for about six hours. The normal temperature is not affected, however.

Action on the secretions: The salicylates increase the secretion of sweat. About fifteen minutes to a half hour after a dose of one of the salicylates is given, the patient is usually covered with profuse perspiration. The salicylates are said to increase the flow of bile.

Action on the circulation: The salicylates usually make the pulse somewhat faster and stronger at first, by increasing the contractions of the heart muscle and contracting the blood vessels.

With larger doses, the contractions of the heart muscle are weakened and the pulse becomes slower and weaker.

The blood vessels of the skin are usually dilated, so that the skin is flushed.

Action on the kidneys: The salicylates increase the secretion of urine. They act as antiseptics along the urinary organs, and make the urine more acid in reaction; due to increasing the amount of uric acid.

Excretion

The salicylates are eliminated from the body as **salicyluric acid**, mainly in the urine; usually in several hours. They are also excreted in the perspiration, milk and bile.

Poisonous Effects

Large doses of salicylates often cause quite alarming symptoms,

especially if used for a long time, but they are rarely fatal. The symptoms resemble those of quinine poisoning.

Symptoms

Overdoses of salicylates cause the following symptoms:

1. **Buzzing and noises in the ears**, and a feeling of fullness in the head.

2. **Deafness.**

3. Dimness of vision.

4. **Profuse perspiration.**

5. Feeling of warmth all over the body.

6. **Occasionally nausea and vomiting.**

In severe cases besides these symptoms there are usually:

7. Dyspnoea, rapid, irregular, deep and labored breathing.

8. Collapse (slow, weak pulse, subnormal temperature, cold, moist skin, etc.).

9. Unconsciousness.

10. Occasionally the patient becomes delirious or even maniacal, and seems to see various objects about him (hallucinations of sight) or he seems to hear voices (hallucinations of hearing).

Death has rarely resulted from salicylate poisoning.

Treatment

1. If the drug is stopped, the symptoms usually disappear in a few days.

2. Caffeine, strychnine, or other heart stimulants are usually given, if the pulse is weak.

Administration

Salicylic acid or the salicylates, are best given in capsules, tablets or in a small quantity of milk or syrup, about an hour or two after meals.

They are best given with sodium bicarbonate to overcome the pain in the stomach, or the nausea and vomiting which may result from the rapid formation of salicylic acid in the stomach.

They are frequently given by injection into the veins.

Preparations

Salicylic Acid	0.3–2.0 Gms.	grs. v–xxx
(Acidum Salicylicum)		

This is more readily dissolved in hot water, and for local use in a solution of boric acid or borax.

Sodium Salicylate	0.3–2.0 Gms.	grs. v–xxx
(Sodii Salicylas)		

This is more soluble than the salicylic acid and is not so apt to upset the stomach. It also comes in 10.0 c.c. ampoules for intravenous injection. Each ampoule contains 1.3 Gms. (grs. xx) sodium salicylate.

Lithium Salicylate (<i>Lithii Salicylas</i>)	0.3-2.0 Gms.	grs. v-xxx
Ammonium Salicylate (<i>Ammonii Salicylas</i>)	0.3 Gm.	grs. v
Strontium Salicylate (<i>Strontii Salicylas</i>)	1.0 Gm.	grs. xv
Oil of Wintergreen (<i>Oleum Gaultheriae</i>)	0.3-1.0 c.c.	m. v-xv

This is a volatile oil obtained by distilling *Gaultheria procumbens* or wintergreen. It contains 90% of methyl salicylate and is given in an emulsion or in capsules. It acts like the salicylates, but it occasionally causes nausea and vomiting. It is frequently used as a local application.

Oil of Sweet Birch (<i>Oleum Betulae</i>)	0.3-1.0 c.c.	m. v-xv
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This is made by distilling the bark of *Betula lenta* or birch bark.

Methyl Salicylate (<i>Methylis Salicylas</i>)	0.3-1.0 Gm.	grs. v-xv
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This is artificial oil of wintergreen. It is contained in oil of wintergreen and in oil of sweet birch.

Salicin (<i>Salicinum</i>)	0.3-2.0 Gms.	grs. v-xxx
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Salicin is a glucoside obtained from the bark of various species of willow and poplar trees. It is changed to salicylic acid in the body.

It has a very bitter taste and is not as reliable in its effect as other preparations of salicylates.

Salol (<i>Phenylis Salicylas</i>)	0.3-2.0 Gms.	grs. v-xxx
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Salol is a tasteless powder which is decomposed by the steapsin of the pancreatic juice in the intestine, into salicylic and carbolic acids. The salicylic acid is absorbed into the blood from the intestines, and it then produces the same effects as the salicylates. It is frequently used as an intestinal and urinary antiseptic. Symptoms of carbolic acid poisoning occasionally result from the carbolic acid which is formed in the intestines.

Salicylic Acid Ointments

These usually contain from 2 to 20% of salicylic acid and are principally used to soften and remove corns. Many salves and plasters used for removing corns consist principally of salicylic acid.

New and Non-official Preparations

Acetylsalicylic Acid (<i>Acidum Acetylsalicylicum</i>)	0.3-1.0 Gm.	grs. v-xv
Aspirin		

This is a compound made chemically from salicylic acid. It is absorbed

in the intestines and then acts like salicylic acid, but because it is very slowly absorbed, its effects are more lasting. It is not so apt to cause poisonous effects. It is commonly used to relieve neuralgic pains and colds.

Novaspirin or Salicitrin 0.3–1.0 Gm. grs. v–xv
(Methylene Citrylsalicylic Acid)

This acts like aspirin but is said not to upset the stomach.

Diaspirin 1.0 Gm. grs. xv

Succinyl Disalicylic Acid

Ethyl Salicylate (Sal Ethyl) 0.3–0.6 c.c. m. v–x
(Aethylis Salicylas)

This is similar to methyl salicylate, and is said not to cause poisonous symptoms.

Sodium Salicylate and Guaiacol

This comes in 5 c.c. ampoules and contains sodium salicylate 1.0 Gm. (grs. xv) and guaiacol 0.12 Gm. (grs. ii) in Ringer's solution. It is given intravenously in the treatment of acute rheumatism and gout.

Mesotan or Ericin

This is an oily fluid made from salicylic acid (methyl oxymethyl salicylate). It acts like the oil of wintergreen and is applied to the skin in an equal part of olive oil.

Salophen 0.3–1.0 Gm. grs. v–xv

This resembles salol in its action. It is changed in the intestines to salicylic acid, and acetylparamidophenol, which is not poisonous. It is therefore safer than salol.

Saloquinine 0.5–2.0 Gms. grs. viii–xxx

This is a compound of quinine and salicylic acid; quinine salicylate. It combines the action of both.

Saloquinine Salicylate 1.0 Gm. grs. xv

This acts like saloquinine.

Spirosal

Monoglycol Salicylate

This is absorbed from the skin and acts like salicylic acid which it forms in the body. It is applied on the skin in solutions containing one part of the drug in three parts of alcohol or in eight parts of olive oil.

Betol or Naphthol Naphtholis Salicylas Cresol Thymosalol	}	These are preparations which act like salol.
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Antipyrine salicylate, Phenocol salicylate, Salipyrine, Melubrin, are all used mostly to reduce fever, though they also act like salicylic acid which they form in the body. (See analgesic antipyretics.)

CINCHOPHEN OR ATOPHAN

Atophan, cinchophen, or **phenylcinchoninic acid**, is a white, crystalline substance which is made chemically from various other complex substances.

Atophan has a specific action in acute gout. **It relieves the pains around the joints very promptly.** It increases the secretion of urine and the elimination of uric acid. Beneficial effects have also been obtained from its use in other chronic joint affections, such as rheumatism and sciatica.

It is not a poisonous drug, and is therefore safer than colchicum, which was formerly the most commonly used drug in gout.

Preparations

Atophan or Cinchophen	0.3-1.0 Gm.	grs. v-xv
Phenylcinchoninic Acid		
Novatophan or Neocinchophen	0.3-1.0 Gm.	grs. v-xv
Chloroxyl	0.3-1.0 Gm.	grs. v-xv
Tolysin	0.3-1.0 Gm.	grs. v-xv

This is the hydrochloride salt of phenylcinchoninic acid.

This is a brand of neocinchophen.

COLCHICUM (MEADOW SAFFRON)

Colchicum is obtained from the seeds and underground stems of the meadow saffron or *Colchicum autumnale*, a small plant growing in Europe and England. The active principle is a substance called **colchicine**.

Action

When given internally, in moderate doses, colchicum irritates the stomach and intestines, causing nausea and vomiting and sometimes diarrhoea. It is slowly absorbed from the stomach.

Colchicum relieves particularly the pains of acute gout, though it is not really a specific for that disease. It also increases the secretion of urine.

Large doses make the pulse and breathing somewhat slower.

Gout: Acute gout is a disease characterized by severe pain, redness and swelling of one or more joints of the body. The joints of the toes and hands are particularly affected, and the pains more often occur at night. The disease is said to be due to the deposit in the joints of crystals of uric acid, which is a constituent of the urine.

Poisonous Effects

Colchicum is a very violent poison, small doses having caused death. An overdose of colchicum usually causes the following symptoms within a few hours:

1. Severe abdominal pain.
2. Nausea, and continual profuse vomiting, which is accompanied by profuse secretion of saliva, tears and mucus from the nose.

3. Profuse diarrhoea, often with bloody stools.
4. Scanty and bloody urine, or there may be no urine secreted at all. Occasionally the urine may be increased.
5. Spasms of the muscles, even convulsions, followed by great muscular weakness, with slow movements and paralysis.
6. Collapse (rapid, thready pulse, slow and shallow breathing, cold moist skin).

Death soon results from respiratory paralysis.

Treatment

1. Give tannic acid preparations, to neutralize the colchicum.
2. The stomach should be washed out.
3. Protect the mucous membrane by white of egg, milk, etc. (demulcents).
4. Keep the patient quiet.
5. The collapse is treated with stimulants, such as caffeine, strychnine, etc.

Preparations

Colchicum Stems

Extract of Colchicum Stems (Extractum Colchici Cormi)	0.03-0.12 Gm.	grs. $\frac{1}{2}$ -ii
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Colchicum Seeds

The preparations of the seeds are principally used.

Wine of Colchicum Seeds (Vinum Colchici Seminis)	0.6-4.0 c.c.	m. x- $\overline{3}$ i
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This contains 10% of colchicum and is the preparation commonly used.

Fluidextract of Colchicum Seeds (Fluidextractum Colchici Seminis)	0.12-0.3 c.c.	m. ii-v
Tincture of Colchicum Seeds (Tinctura Colchici Seminis)	0.3-1.0 c.c.	m. v-xv
Colchicine (the active principle)	0.0005 Gm.	gr. $\frac{1}{120}$

PIPERAZINE

Piperazine is a chemical substance which is frequently used to relieve gout, and to dissolve stones in the kidney and bladder. Its use is based on the fact that it dissolves uric acid crystals, when added to them in a test tube. The use of this drug on patients does not corroborate this effect. It slightly increases the flow of urine, however.

Preparations

Piperazine (Piperazina)	0.3-0.6 Gm.	grs. v-x
Lycetol	1.0-2.0 Gms.	grs. xv-xxx
Dimethyl Piperazine Tartarate		
Sidonal or Piperazine Quininate (Piperazinae Quinnas)	1.0-1.3 Gm.	grs. xv-xx

CIMICIFUGA (BLACK SNAKEROOT)

Cimicifuga is obtained from the roots and underground stems of the *Cimicifuga racemosa*, an American plant which grows abundantly in shady woods. It is used as a bitter, to relieve gout and rheumatism, and occasionally to relieve nervousness.

EMETINE

Emetine is a white powder, the active alkaloid of *ipecac*. It was formerly used only to produce vomiting. Locally it is an antiseptic. It is especially destructive to amoebae, which are unicellular organisms, many species of which cause disease, particularly in the large intestine. Even a solution of 1 to 1,000,000 destroys amoebae.

Applied to the skin emetine is very irritating and may cause pustules if applied long enough.

When given by mouth or hypodermically in large doses it causes nausea and vomiting, and diarrhoea. Emetine is used principally as a specific for amoebic dysentery, a form of dysentery caused by a species of amoebae.

Emetine has also been used extensively in the treatment of pyorrhoea alveolaris, a chronic infection of the teeth sockets. Amoebae are found in the pus obtained from these teeth, but they are evidently not the cause of the disease. Emetine is beneficial in this disease but it does not cure it. It has also been used to check hemorrhage from the lung (haemotypsis).

Poisonous Effects

The poisonous effects of emetine are abdominal pain, especially when passing stool, and sometimes delirium.

Emetine Hydrochloride	0.01-0.02 Gm.	gr. $\frac{1}{8}$ - $\frac{1}{3}$
Emetine Bismuth Iodide	0.2 Gm.	grs. iii

This is given in capsules or cachets in chronic dysentery.

RADIUM

Radium is a chemical element obtained from Hungary and from certain regions of the United States. The salt commonly used in medicine is **radium bromide**. It differs from other chemical substances in a very singular way. Radium is constantly giving off atoms in the form of invisible rays which are capable of producing energy and destroying tissue. Substances which have this property are said to be **radioactive**. The constant loss of the atoms takes place so slowly that the action of the radium is not materially lessened by constant use. In fact, it is claimed that radium will retain its activity for about 2500 years.

The active rays of radium are able to destroy tissues and are of three kinds: **alpha**, **beta** and **gamma** rays. The gamma rays are the most penetrating and are able to reach deep tissues, while the alpha and beta

rays affect only the superficial cells. The alpha rays may be screened off by interposing a piece of paper between the radium and the tissue to be affected, and the beta rays by a thin piece of lead.

Action

Radium acts only locally, on direct application to the tissue to be treated. If a tube of radium is applied for some time on the normal skin, it will produce a red and tender area with the formation of a scab. A longer application, or a stronger tube, will form an ulcer which heals readily, however.

When applied for some time to a cancer, radium destroys some of the cancer cells, checks its growth and relieves the pain.

Uses and Administration

Radium is used principally in the treatment of cancer and rodent ulcer (a peculiar progressive form of ulcer which spreads over the face and destroys the tissues).

It is usually applied by inserting a gold, silver, or platinum covered tube of radium into the cancer tissue or by placing it on the ulcer.

Radium Emanation

Radium emanation is a gas which is constantly being given off from radium. It is obtained by placing a radium containing substance in a bottle of water and allowing it to stand for some time, until the water becomes charged with the emanation. This is used as a drink in chronic rheumatism and gout with beneficial results.

The gas may also be collected from the surface of the water and is used as an inhalation in the treatment of diseases of the lungs.

There are several types of apparatus on the market for the preparation of radioactive waters.

Radium needles are small thin needles made of a radium containing substance. They are inserted into tumors and allowed to remain in them to obtain the continued action of radium.

Preparations

The following are the salts of radium usually applied:

Radium Bromide
Radium Carbonate
Radium Chloride
Radium Sulphate

Thorium and **Mesothorium** are two other radioactive substances that are used in the treatment of cancer. They are much cheaper than radium but not as active.

CHAPTER XXXII

ORGANIC REMEDIES

ORGANS OF ANIMALS AND THEIR DERIVATIVES

Organic remedies are substances made from various organs of animals. They are used as specific remedies to supply definite substances to the body where a similar organ is deficient or so diseased that it is incapable of providing its necessary secretions or substances. This form of specific therapy is called **substitution therapy**. Most of the organic remedies are made from ductless glands and are given in diseases of these glands in which they are unable to supply the body with their specific secretions.

Physiology of Ductless Glands

A gland is an organ consisting of secreting cells which produce a secretion. There are two kinds of glands—secretory and incretory. A secretory gland pours a substance into some hollow organ. The salivary glands and the liver are examples of secretory glands. They pour their specific secretions into the mouth and into the intestinal tract through a tubular structure called a duct.

The incretory or ductless glands are glands without ducts. They are very important organs and they probably pour a substance into the blood stream which is capable of modifying physiological processes, or they may change the blood in some other way by modifying some of its constituents. Examples of the incretory glands are the thyroid, the pituitary, the adrenals, the thymus and the parathyroids.

There are some glands that are both secretory and incretory. For example, the pancreas secretes a digestive juice into the intestinal tract and also produces a substance which it secretes into the blood stream from the Islands of Langerhans, small groups of cells embedded in the gland. This internal secretion regulates the metabolism of sugars. When it is deficient an excess of sugar is present in the blood and diabetes results.

The ovaries and the testes are also combined secretory and incretory glands.

There are a number of organic products which are obtained from other organs than the ductless glands. For example, the digestive ferment, pepsin, is an organic product obtained from the lining membrane of the stomach and contains the actual digestive ferments of the stomach. Pancreatin is a similar extract obtained from the pancreas, which contains its digestive ferments.

The treatment of disease by substances obtained from organs of

animals is a very promising field of therapeutics. Within the last two decades the most startling progress in the treatment of disease by this means has been made.

Pituitrin and adrenalin are very effective remedies which are obtained from the pituitary and from the adrenal glands. Insulin, a specific remedy for diabetes, is a substance obtained from the pancreas. This and thyroid extract are examples of the best and most effective organic remedies.

The striking effects obtained by the use of these preparations has developed an increasing tendency in many physicians to use glandular substances extensively. They are given in many diseases besides diseases of glands, in which the symptoms are believed to indicate a deficient secretion of one or of several ductless glands. For example, myxoedema is a disease due to deficient secretion of the thyroid gland, and is characterized by drowsiness, sluggish mentality, and the development of characteristic fat pads. When such symptoms occur in other diseases in a mild degree, they are believed to indicate deficient thyroid secretion.

INSULIN

Insulin or Iletin is a watery solution containing the active substance of the Islands of Langerhans of the pancreas of animals. It is also made from the pancreas of fishes and from vegetable substances such as onions, and from certain kinds of yeast.

ACTION

Diabetes

Diabetes is a disease of metabolism in which the patient is unable to utilize carbohydrates and sugars. As a result, the percentage of sugar in the blood is increased and the patient excretes sugar in the urine. In some cases of diabetes the patient is also unable to burn up fats, with the result that acid by-products of the fat remain in the blood and decrease its alkalinity, producing a condition called **acidosis**. This is characterized by the presence of acetone and diacetic acid in the urine, which is an indication that acid by-products are present in the blood in excess. When the acidosis is marked, stupor, coma, twitchings, irregular breathing develop, and death may result.

The specific cause of diabetes is a disturbance of the internal secretion of the Islands of Langerhans of the pancreas.

Effect of Insulin in Diabetes

Insulin is used as a specific remedy for diabetes. It reduces the sugar in the blood and urine, and if given in sufficiently large quantities, it abolishes the sugar in the urine. As a result, the patient gains in weight and feels generally better. It also accelerates the burning up of fats in the body, relieving the condition of acidosis and reducing the acetone and diacetic acid in the urine.

In most cases of diabetes the patient is able to utilize a certain percentage of carbohydrates and fats, but not as much as a normal individual. The quantity of carbohydrates that the patient can take in the diet without showing sugar in the urine and unduly raising the percentage of sugar in his blood is known as the carbohydrate or sugar tolerance. The amount of fat that the patient can take without showing acetone or diacetic acid in the urine is his fat tolerance.

If the quantity of carbohydrates and fats in the patient's diet is insufficient to supply the necessary calories and to maintain nutrition so that the patient loses in weight, or if the patient cannot be kept on a diet which will keep the urine free from sugar, it is necessary to administer **insulin**. The dosage of insulin depends on the amount of sugar in the urine and the amount of carbohydrates that the patient is given in the diet.

Poisonous Symptoms

Insulin Shock or Hypoglycaemic Reaction

Overdoses of insulin cause serious symptoms which require immediate attention. These symptoms result when the percentage of sugar in the blood is reduced below 0.045 (the normal percentage is 0.08–0.15), and sometimes when the percentage of blood sugar is suddenly reduced by large doses.

Symptoms

- 1 Weakness.
2. Fatigue.
3. Nervousness.
4. Tremors.
5. This is followed by profuse sweating, which is the most characteristic sign.
6. Pallor and flushing
7. This may be followed by drowsiness, unconsciousness and even coma.

Treatment

The patient should be cautioned about these symptoms and instructed what to do when they occur. Whenever insulin is administered, the nurse should be constantly on her guard for the symptoms of poisoning, since they sometimes occur while the patient is asleep. To prevent insulin shock in ambulatory patients it is better to give such doses of insulin which will not completely eliminate the sugar in the urine. As long as the urine contains even a trace of sugar, the chances of developing insulin shock are very slight.

The symptoms can be relieved at once by giving the patient sugar in some form; by a glass of orange juice or a lump of sugar. In severe cases, a solution of glucose may be given through a stomach tube. A hypodermic injection of epinephrine or adrenalin 0.3–0.6 c.c. of a 1–1000 solution will clear up the symptoms immediately. This should be followed, however, by administration of carbohydrates by mouth.

Uses

Insulin is used as a specific remedy for diabetes. It is also used in acidosis following anaesthesia or from other causes.

Administration

Insulin is given hypodermically two or three times a day, fifteen minutes to a half hour before meals, depending on the rapidity with which the patient absorbs sugars and insulin. It is usually given in doses called **units**, and the dose depends on the percentage of sugar in the urine and in the blood.

A unit is one-third of the amount of insulin necessary to reduce the blood sugar to 0.045% for five hours, in a rabbit weighing 2 kilograms, after 24 hours' starvation. Each unit will neutralize about $2\frac{1}{2}$ Grams of sugar. In some patients a unit will neutralize 1 and in others as much as 4 Grams of sugar, and the dosage is modified accordingly.

In cases of coma or severe acidosis, insulin is frequently given intravenously. About 20 to 40 units or more, depending on the severity of the case, are given together with about 100 to 300 c.c. of a 5% to 50% glucose solution intravenously to prevent insulin shock. Some physicians give the insulin without the glucose, when the blood sugar percentage is high, but examine the urine and blood repeatedly to determine if an effect has been obtained. The doses are repeated every few hours until the acidosis is cleared up.

In milder cases of acidosis, large doses of insulin, about 10 or 20 units or more, depending on the severity of the case, are given hypodermically every hour or two, with or without glucose solution, by mouth, by rectum or by hypodermoclysis. It is rarely necessary, even in coma, to give more than 150 units of insulin in 12 hours. In addition to the insulin, many physicians give large doses of sodium bicarbonate to neutralize the acid products in the blood.

Preparations

Insulin or Iletin

This is usually given hypodermically or intravenously. It comes in ampoules in three strengths as follows:

U 10 contains 50 units, each c.c. containing 10 units.

U 20 contains 100 units, each c.c. containing 20 units.

U 40 contains 200 units, each c.c. containing 40 units.

THYROID OR THYROID EXTRACT

Thyroid or thyroid extract is a dry powder obtained from the thyroid glands of sheep or other animals by grinding and drying the gland and thus concentrating it to about 1/5 of its volume. The active principle is believed to be **thyroxin**, a complex iodine preparation which contains 65.1% of iodine.

The thyroid gland is a large gland situated in the neck and is a very important gland in the body. In childhood, it controls growth and development. In adult life it controls the rate of metabolism, and is an important factor in the functions of the nervous system and other organs.

In diseases of the thyroid gland, the degree of activity of the gland can be definitely measured by determining the rate of metabolism of the patient. This is determined by means of a special apparatus which measures the amount of oxygen the patient consumes and the carbon dioxide produced, while at rest. This test is called a basal metabolism test. When the thyroid secretion is excessive, the basal metabolism is increased, and when it is diminished the rate is lowered.

ACTION

Thyroid extract is particularly effective when the thyroid gland is absent or when its secretion is deficient. It acts, therefore, as a specific for cretinism and myxoedema by supplying a definite deficient substance.

Cretinism is a condition occurring in childhood which is characterized by slow and stunted growth, dry, scaly skin, sluggish mentality and a peculiar puffy obesity.

When thyroid extract is given steadily to such children, there

is a rapid, startling improvement in growth, in development, and in mentality, and a general acceleration of all functions.

Myxoedema is a condition which is due to the gradual atrophy of the thyroid gland. This condition occurs principally in women, usually after the age of 40, and is characterized by sluggish mentality, dry skin, drowsiness, slow pulse, obesity, and the rate of metabolism is lowered.

The administration of thyroid extract to such patients causes a striking improvement of these symptoms. The patient becomes more alert, energetic, the pulse and general condition is improved the rate of metabolism is markedly increased, and all mental processes are accelerated.

There are mild cases of myxoedema in which only a few of the symptoms are present but which respond promptly to thyroid extract.

Thyroxin

When thyroxin is given intravenously, or when large doses of thyroid extract are given by mouth, for 5 or 6 days, the pulse rate is increased; there is a loss in weight, nervousness, palpitation of the heart, fatigability and the basal metabolic rate is increased. Each dose of 0.001 Gm. (one milligram) of thyroxin increases the basal metabolic rate 2%.

Uses

In addition to its specific use in cretinism and myxoedema, thyroid extract is used in a number of conditions of faulty development in children. It is also used in various diseases in adults where a deficiency of thyroid secretion is suspected from symptoms simulating myxoedema, or when indicated by a low basal metabolic rate. It is used for this purpose in some cases of obesity, since there is an increase in weight in myxoedema and since a thyroid deficiency is believed to be a cause of some cases of obesity.

It is used in the treatment of some cases of goiter, especially in young girls, and when the basal metabolic rate is lowered.

Various menstrual disturbances are sometimes due to deficiency in thyroid secretion and thyroid extract is often given for this purpose.

Poisonous Effects

Thyroid extract frequently causes poisonous symptoms, especially in women who take it in large doses to reduce in weight. The following symptoms are produced:

1. Rapid loss in weight.
2. Rapid, thready pulse.
3. Nervousness.
4. Palpitation of the heart.
5. Fainting spells.
6. Sleeplessness.
7. Diarrhoea.

COMMON DISEASES OF THE THYROID GLAND

Exophthalmic Goiter and Hyperthyroidism

The thyroid gland frequently produces its secretion in excess. This condition occurs in two forms known as Hyperthyroidism and Grave's Disease, or Exophthalmic Goiter, producing the following symptoms:

1. Loss in weight
2. Palpitation of the heart
3. Nervousness and tremors
4. Exophthalmos (bulging of the eyeballs)
(This occurs principally in Graves' Disease.)
5. Excessive perspiration
6. Flushing of the face
7. Diarrhoea
8. Sleeplessness.
9. Increased rate of metabolism

Endemic or Simple Goiter is an enlargement of the thyroid gland which is very common in mountainous and inland districts. It is believed to be due to a deficiency of iodine in the water. It is treated by giving small quantities of iodine either in the form of Lugol's solution, in the form of a salt or in the form of chocolate. The thyroid gland also becomes enlarged at puberty and during pregnancy.

Preparations

Thyroid, formerly **Thyroid Extract** 0.006–0.3 Gm. grs. $\frac{1}{10}$ -v
(**Thyroideum Siccum**, formerly **Glandulae Thyroidae Siccae**)

This is dried thyroid glands of sheep or other animals.

Thyroxin 0.00002–0.0002 Gm. gr. $\frac{1}{3000}$ – $\frac{1}{300}$

This is the active principle of the thyroid gland. It is a complex iodine compound containing 65.1% of iodine. It is given principally intravenously, neutralized with sodium hydroxide, and also by mouth. The dose depends on the basal metabolic rate. In myxoedema 0.00015–0.0002 Gm. is given a day. In cretinism it is given in doses of 0.00002–0.00004 Gm. every other day. When the basal metabolic rate is increased the dose is gradually reduced. If excessive doses are given, symptoms of hyperthyroidism are produced (see above).

Thyroxin Crude 0.00002–0.0008 Gm. gr. $\frac{1}{3000}$ – $\frac{1}{75}$

This is a purified disodium salt of thyroxin which comes in tablets and is given by mouth in a tumblerful of water.

Antithyroidin Moebius 0.5–1.0 c.c. m. viii–xv

This is the serum of goats whose thyroid glands have been removed about six weeks before the serum is removed. It is used in the treatment of Exophthalmic goiter and Hyperthyroidism (excessive thyroid secretion).

Thyroidectin 0.3 Gm. grs. v

This comes in gelatin capsules which contain a powder made from the dried blood of animals whose thyroid glands have been removed. It is used in cases of excessive thyroid secretion (Hyperthyroidism or Exophthalmic Goiter).

Thyroid Nucleoprotein

This is iodized nucleoproteins of the thyroid glands of pigs and sheep, which comes in tablets each containing 0.06 Gm. (gr. i). It comes in 1, 2, 5 and 10% strengths, the latter being equivalent to ordinary dried thyroid extract. It is used for the same conditions as thyroid extract.

Thyroid Residue 0.12-0.6 c.c. m. ii-x

This is the residue of the thyroid gland after the nucleoproteins have been removed. It contains about 5% of iodine. It is used in cases of hyperthyroidism with gastro-intestinal symptoms.

PARATHYROID EXTRACT

Parathyroid extract is a dried powder made from the parathyroid glands of sheep or other animals. They are very small glands situated in the region of the thyroid gland.

Action

The action of the parathyroid glands can best be understood by a study of the symptoms that result from their removal. Since the parathyroid glands are imbedded in the thyroid gland, this sometimes happens after operations for the removal of the thyroid gland.

The removal of the parathyroids is followed by a condition known as tetany. This condition also occurs spontaneously in children. It is characterized by the occurrence of intermittent, spasmodic, or tetanic contractions of the muscles of the arms and hands, and sometimes also of the lower extremities.

These symptoms are due to the deficient function of the parathyroid glands. Since they regulate the metabolism of calcium salts, the removal of the parathyroid glands produces deficiency of calcium in the body. The nerves then become more irritable, and spasms occur; since calcium is a necessary substance for normal function of nerve tissues.

Uses

In addition to its use in tetany, parathyroid extract is also given to lessen the twitchings of the hands in paralysis agitans, a disease

characterized by continual twitchings of the hands, and a shuffling gait. It is also used to lessen the convulsions of eclampsia, a condition occurring in pregnancy.

A disturbance of calcium metabolism and possibly in the function of the parathyroid glands is also believed to be present in various infections and in ulcer of the stomach, leg ulcers, hay fever, asthma and urticaria. Parathyroid extract is therefore sometimes given for these conditions.

Preparations

Parathyroid Extract

0.003–0.006 Gm.

gr. $\frac{1}{20}$ – $\frac{1}{10}$

Desiccated Parathyroid Gland

PITUITARY OR PITUITARY EXTRACT

Pituitary or pituitary extract is a dried powder made from the pituitary gland of the ox or other animals.

The pituitary gland is a small ductless gland situated at the base of the brain, which probably secretes a substance into the blood stream. The gland consists of two parts: an anterior lobe and a posterior lobe, each having a different function. The active principle of the anterior lobe has not been isolated, but it is thought to be a substance called **tethelin**. The posterior lobe contains a substance, **puitrin**, which produces definite effects when used as a medicine.

Action

The effect of the pituitary gland on the body can best be understood by a study of the symptoms which result when the gland is secreting excessively or when its secretion is deficient. Since each lobe has a different function, the effects differ according to whether the anterior or posterior lobe, or both lobes, of the gland are involved.

The **anterior lobe** of the pituitary gland regulates growth and development, particularly of the bones and the genital organs.

The **posterior lobe** of the gland contains puitrin. When this is injected hypodermically, it produces contractions of the involuntary muscles of the intestines and uterus; it raises the blood pressure; it contracts the bladder, and increases the flow of urine and the secretion of milk. It is also a specific for diabetes insipidus, a disease characterized by excessive thirst and the secretion of large quantities of urine.

Disturbances of the Pituitary Gland

When the anterior lobe of the pituitary gland secretes excessively, a condition known as **gigantism** and **acromegaly** develops.

If the disturbance occurs in childhood before the bones have completely ossified, it is characterized by excessive growth of the skeleton. The individual is of large stature; he has abnormally long extremities, and may be a giant (gigantism).

If the disturbance in the gland occurs later in life, after the period of adolescence, a condition known as acromegaly develops. The patient may be of large or average stature but the bones of the face are enlarged and thickened so that the features become coarse, large and prominent (the so-called lion-like face). The soft tissues also become enlarged. The hands and fingers and the feet and toes become thick and broad. There is an extensive growth of thick bushy hair over the body. These patients suffer from a peculiar boring headache in the temples.

When the secretion of the anterior lobe of the pituitary gland is diminished, usually as a result of a very small-sized or atrophic gland, the individuals remain dwarfs, if this disturbance occurs in infancy. If it occurs later in life, the individuals show defective bone development generally and a tendency to obesity.

When there is a disturbance of both lobes of the pituitary gland, which usually is a result of disease, the secretion is markedly diminished and the condition known as **Hypopituitarism** or **Dystrophia adiposogenitalis** or Froehlich's syndrome results. This is characterized by obesity in which the fat occurs principally on the abdomen and buttocks, and a change in the outward physical sex characteristics of the individual. If the patient is a woman the breasts become smaller, she stops menstruating and develops a growth of hair on the face. In male patients the growth of hair on the face diminishes, the breasts become larger and the sexual glands become atrophied.

These patients suffer with a peculiar boring headache, accompanied by nausea and which occurs in women usually before menstruation.

Pituitary disease is sometimes due to a tumor, and then, in addition to the other symptoms, there develops a peculiar blindness in which patients do not see objects on the outer side of the visual field, due to pressure on the optic nerve.

Uses

Pituitary extracts are used to supply deficient secretion of the anterior lobe of the pituitary gland in hypopituitarism, infantilism, dwarfism, the Froehlich syndrome, and in the late stages of acromegaly. They do not modify the physical symptoms of these

conditions but they frequently relieve the headaches. They are also used to relieve certain types of headaches which occur before menstruation. Since deficient action of the pituitary gland is characterized by a diminished menstrual flow, pituitary extract is also given to increase the menstrual flow, especially in cases where there is evidence of pituitary disturbance. It is also given in epilepsy.

Pituitrin or posterior pituitary liquid is used as a heart stimulant in shock or collapse and to raise the blood pressure. It is also used to increase peristalsis in abdominal distention (tympanites) following operations and in the course of various infections, and to increase uterine contractions in labor. It is used to check the excessive secretion of urine in diabetes insipidus, which is believed to be due to deficient action of the posterior lobe of the pituitary gland.

Poisonous Effects

When excessive doses of pituitary extract are given there usually occurs a characteristic headache in both temples and abdominal cramps, which indicate that the drug should be

Preparations

Pituitary or Dessicated Pituitary Body	0.06–0.3 Gm.	grs. i–v
Dessicated Hypophysis		
Hypophysis Sicca		

This is the dried substance of the entire pituitary gland of the ox. It comes in tablets or powders

Dessicated Pituitary Substance (Anterior Lobe)	0.06–0.3 Gm.	grs. i–v
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This is the powdered dried substance of the anterior lobe of the pituitary gland of the ox. It also comes in tablets.

Dessicated Pituitary Substance (Posterior Lobe)	0.06–0.25 Gm.	gr. i–iv
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This is the dried powdered posterior lobe of the pituitary gland of the ox.

Solution of Pituitary or Solution of Hypophysis	1.0 c.c.	m. xv
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(**Liquor Pituitarii** or **Liquor Hypophysis**)

Pituitrin

This is a sterile solution of the extract of the posterior lobe of the pituitary gland. It comes in ampoules each containing 1.0 c.c. (m. xv).

ADRENAL EXTRACT

Adrenal extract is made from the dried suprarenal or adrenal glands of the sheep and ox. These glands are situated immediately above the kidneys and they consist of two portions: an outer part or cortex, and an inner portion or medulla. Epine-

phrine or adrenalin is made from the medulla, while a different extract is made from the cortex.

Action

The action of adrenal extract is best understood by a study of the symptoms which result when the gland is removed or diseased. The cortex and medulla have different functions, but both have a profound effect upon the functions of the body. The function of the cortex is not definitely known, but it is believed to play a part in the development and growth of the sexual organs.

When the adrenals are removed, sudden death results. This is due principally to the removal of the cortex. It has recently been shown that a disturbed function of the adrenal cortex may be a cause of Hyperthyroidism or Graves' disease.

The medulla of the gland secretes a substance into the blood, epinephrine, which acts on all the involuntary muscles by stimulating the nerve terminals of the sympathetic system. It is believed to be secreted in excess in emotions.

Epinephrine or adrenalin is a substance obtained from the medulla of the gland which produces similar effects. It contracts the involuntary muscles in the small blood vessels, raising blood pressure for a short time, slowing the pulse, dilating the pupil, increasing the secretions, such as the saliva, the tears, and contracting the involuntary muscles of the intestines.

Diseases of the Adrenal Glands

A diseased condition of the adrenal glands occurs which is known as **Addison's disease**, and is usually due to tuberculosis. It is characterized by extreme weakness, low blood pressure, and pigmented blotches on the skin. It is usually fatal.

It is also believed that the extreme weakness, lack of energy and low blood pressure, sensitiveness to heat and cold, anaemia and constipation which follow infections, or which occur in run-down conditions are due to insufficient function of the adrenal glands. This group of symptoms is sometimes called **adrenal insufficiency**.

Uses

Dried adrenal extract is used in Addison's disease, but since this is such an extensive involvement of the adrenal glands the substance is not very effective. It is also used in conditions of "adrenal insufficiency" following infections and run-down conditions or in neurasthenia.

Epinephrine or adrenalin is used as a heart stimulant, in

shock or collapse, as a remedy for attacks of asthma and for urticaria.

Suprarenal cortex or adrenal cortex is used in the treatment of Graves' Disease and Hyperthyroidism.

Preparations

Dried Suprarenal Gland (Suprarenalum Sicca)	0.015-0.3 Gm.	grs. $\frac{1}{4}$ -v
Suprarenal or Adrenal Extract		

This is the dried adrenal glands of sheep or ox.

Epinephrine or Adrenalin (see page 228).

Adrenal Nucleoprotein

This is obtained from the adrenal glands of the ox or sheep. It contains 10% of the nucleoproteins of these glands. It is given in doses of one or two tablets every 2 or 3 hours for the stomach symptoms of exophthalmic goiter.

Adrenal Residue

This is the remains of the adrenal gland after the nucleoproteins have been removed. It is a liquid which is given in doses of 0.2-0.3 c.c. (m iii-v) for exophthalmic goiter and hyperthyroidism.

Suprarenal or Adrenal Cortex	0.06-0.6 Gm.	grs. i-x
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This is a dried extract of the cortical part of the adrenal glands. It also comes as a freshly prepared glycerin extract which is given in large doses.

OVARIAN EXTRACTS

Ovarian extracts are dried powders made from the ovaries of cattle. The ovaries are glands situated on either side of the uterus.

Action

The ovaries secrete an ovum into the uterus every month. This is associated with the phenomenon of menstruation. They also probably secrete some substance into the blood stream which affects metabolism, the nervous system, and produces the feminine physical characteristics.

The function of the ovaries are best understood by a study of the symptoms which result when they are removed.

When the ovaries are removed before puberty, development of the sexual organs is retarded. Menstruation does not take place, the uterus remains small and the breasts do not develop.

It is believed that the internal secretion of the ovaries which is responsible for these changes is produced by small yellow bodies formed at the site in the ovaries from which each ovum is discharged. This is called the corpus luteum. It increases in size during pregnancy and is probably an important element in maintaining pregnancy.

When both ovaries are removed after puberty, menstruation ceases. The uterus, breasts and vagina gradually become smaller and atrophied, and the patient suffers from various symptoms, such as flushing of the face, nervousness and obesity.

These symptoms may also occur at the menopause, which is the period when a woman ceases to menstruate, and it is believed that they are due to gradual atrophy of the ovaries, which occurs at that time. Similar symptoms occur after an operation for the removal of both ovaries.

Uses

Ovarian extract and corpus luteum are used for the following conditions:

1. To remove the hot flushes, the nervous symptoms, obesity and headaches which occur after operative removal of both ovaries, or at the menopause, by supplying the deficient ovarian secretion.

2. To relieve amenorrhoea (delayed or absent menstruation), since this occurs when the ovaries are removed.

3. To relieve excessive vomiting in pregnancy. In this condition it is given principally by intramuscular or intravenous injection.

4. To relieve dysmenorrhoea (painful menstruation).

5. To relieve menorrhagia (excessive menstrual bleeding) and metrorrhagia (excessive bleeding between menstrual periods).

Preparations

Ovarian Substance	0.06-0.6 Gm.	grs. i-x
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Ovarian Extract

Whole Ovary

These are dried extracts of the ovaries of the hog or cow.

Dessicated Corpus Luteum	0.12-0.3 Gm.	gr. ii-v
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This comes in capsules or tablets made from the corpora lutea of fresh cow's ovaries. Corpus luteum also comes in ampoules for intramuscular or intravenous injection.

Lutein	0.06-0.3 Gm.	gr. i-v
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This is made from the corpus luteum of the hog but it is 4 times as strong as the fresh substance. It also comes in ampoules for intravenous and intramuscular injection, each containing 0.2 Gm. (grs. iii).

Ovarian Nucleoprotein	0.06 Gm.	gr. i
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This is a powder made from the ovaries of the cow or pig which contains 10% of the nucleoproteins of the gland.

Ovarian Residue 0.12–0.3 Gm. grs. ii–v

This is the dried extract of the ovaries of the cow, from which the corpus luteum has been removed.

Glovarian Pills

This is a concentrated glycerin extract of the ovaries which is said to contain all the corpora lutea and fatty substances.

Agomensin Each tablet contains 0.02 Gm. gr. $\frac{1}{3}$
Dose: 1 to 3 tablets t.i.d.

This is a substance obtained from the corpus luteum of the pig or cow in the early stage of its development. It is used for amenorrhoea and the symptoms of the natural or artificial menopause.

Sistomensin Each tablet contains 0.012 Gm. gr. $\frac{1}{8}$
Dose: 1 to 2 tablets t.i.d.

This is a substance which is made from the corpus luteum of the hog or cow when it is fully developed. It is used to check excessive menstruation (menorrhagia), painful menstruation and excessive uterine bleeding at the menopause.

THYMUS EXTRACT

Thymus extract is a powder made from the fresh thymus glands of the calf. This is a gland which is situated in the chest behind the sternum. It is believed to have an important function in growth, development and the physiology of childhood. This gland disappears at the time of puberty.

Dried extracts of the thymus gland are used in cases of defective growth and defective physical or mental development, because this is believed to be due to a deficiency of the thymus gland. The dose is 0.3 Gm. (grs. v).

PLACENTAL EXTRACT

This is the dried extract of the placenta or after-birth. Extracts of the placenta have been used to check excessive menstruation, and to check excessive secretion of milk, since in pregnancy, when the after-birth is present, menstruation ceases and the secretion of milk does not occur. The dose is 0.3 Gm. (grs. v) or more.

PINEAL EXTRACT

The pineal gland is a tiny gland situated in the brain. Since tumors of the pineal gland have been associated with a precocious development of the genitals and precocious mental activity, pineal gland extracts are used in the treatment of mental deficiency. The dose is 0.006 Gm. (gr. $\frac{1}{16}$).

MAMMARY EXTRACT

Mammary Extract is a yellowish powder made from the mammary gland or breasts, of the sheep. Since the nursing mother does not menstruate and nursing by the infant helps to contract the uterus, it is believed that the breasts have an internal secretion. Consequently dried extracts of the mammary glands are given to contract the uterus and to check profuse menstruation (menorrhagia), metrorrhagia (excessive bleeding between periods), and the excessive bleeding which sometimes occurs at the time of the menopause.

Mammary Substance 0.12–0.3 Gm. grs. ii–v

CHAPTER XXXIII

SERUMS, VACCINES AND ALLERGENS

SERUMS

When a patient suffers from an infectious disease, and recovers, the disease has been overcome by the formation in the blood, of antibodies (antidotes) against the causative agent of the particular infection. The patient is then said to have developed an **active immunity** against the disease, because he himself has formed the antibodies (antidote).

Similarly, when an animal is injected with bacteria or their poisonous excretions (toxins) in gradually increasing doses, the animal develops an active immunity against the injected bacteria or their toxins. The injected substance is called the antigen. Each injection is followed by a reaction, such as a rise in temperature, and all the symptoms of fever. When a point is reached that the animal can stand injections of large doses without showing a reaction, immunity is produced. The essential point, however, in the preparation of serums is the fact that when antibodies are formed they are produced in excess.

The serum which is removed from the veins of the immunized animal contains free, uncombined antibodies. This **serum** can then be injected into patients to overcome an infection caused by the same organism which was used in making the serum. As a result of such injections the patient becomes immunized against the disease. Immunity produced in this way is called **passive immunity** because it was the result of antibodies (antidotes) formed in the blood of another animal.

A serum is the serum of an animal that has been immunized against a specific bacterium or its toxins. Serums are of two kinds: **bacteriolytic**, and **antitoxic**.

BACTERIOLYTIC SERUMS

A bacteriolytic serum is the serum of an animal that has been immunized against specific bacteria. The horse is the animal commonly used for the manufacture of serums, since the largest quantity of serum can be obtained from this animal.

Method of Manufacture

A horse is injected with a small dose of a solution of the particular bacteria against which the serum is desired. As a result of the injection, the horse becomes ill and has a rise of temperature which disappears in a few days. When the animal is well again, the injection is repeated, but with a larger dose; which now does not produce such severe symptoms.

The injections are again repeated, but in gradually increasing doses, until the animal can stand injections of large doses of the bacteria without developing any symptoms. The horse is then immune to these particular bacteria, and his serum contains antibodies (antidotes) against them.

The animal is then bled from the jugular vein, the blood is allowed to clot, and the serum is removed under strictly aseptic precautions. This serum, when injected into patients suffering from an infection produced by the same bacteria, neutralizes their poisonous effects; the antibodies of the serum combining with the bacteria.

Administration of Serums and Vaccines

The serums and vaccines are usually given hypodermically or intramuscularly. For immediate effect many serums are injected intravenously. In some patients the injection of a serum produces an allergic reaction or anaphalaxis (see page 460).

The susceptibility of a patient to a serum may be tested by injecting a few drops of the serum hypodermically, and noting whether a small oedematous (swollen) red spot occurs at the site of injection.

Preparations

Antistreptococcus Serum

This serum is used in the treatment of septicaemia, erysipelas, and scarlet fever. It is made by immunizing horses against killed or living Streptococci. There are various strains of Streptococci such as Streptococcus haemolyticus, Streptococcus viridans, etc.

Polyvalent Antistreptococcus Serum

This is made by immunizing horses against several different strains of Streptococci.

Antistaphylococcus Serum

This is made by immunizing horses against dead Staphylococci. It is used in the treatment of sepsis caused by Staphylococci.

Antipneumococcus Serum

This is the serum obtained by immunizing horses against virulent dead and living Pneumococci. It is used in the treatment of pneumonia.

There are four strains of Pneumococci, Types 1, 2, 3, and 4. The best results are obtained with Type 1 serum. It is given intravenously, in doses of 50 to 100 c.c.

Antigonococcus Serum

This is the serum of rams immunized against dead and living Gonococci. It is especially valuable in the treatment of gonorrhoeal joints.

Antidysenteric Serum

This is the serum of horses immunized against the dysentery bacillus (Shiga bacillus). It is given in doses of 20 to 100 c. c.

Antimeningococcus Serum

This is the serum of horses immunized against several strains of dead and living Meningococci. It is injected in 15-30 c.c. doses into the spinal canal, after the same amount of fluid has been withdrawn.

Antityphoid Serum

This is the serum of horses injected with dead cultures of Typhoid bacilli.

Antianthrax Serum

This is the serum of a horse immunized against Anthrax bacilli. It is given in 30 to 100 c. c. doses.

ANTITOXIC SERUMS

An antitoxic serum is the serum of an animal that has been immunized against the poisonous excretions (toxins) of bacteria, but not against the bodies of the bacteria themselves.

Antitoxic serums are prepared in the same way as antibacterial serums but the animal is repeatedly injected with a filtrate of a bouillon culture of the bacteria obtained through a Berkefeld filter. This filtrate contains only the toxins of the bacteria, but not their bodies.

Preparations

Diphtheria Antitoxin Serum

This is the serum of a horse that has been immunized against the toxin of the diphtheria bacilli. It contains antibodies against the diphtheria toxin. When the serum is injected into a patient suffering from diphtheria, the antibodies combine with the diphtheria toxin, thereby neutralizing the symptoms of the disease.

Diphtheria antitoxin is the most efficient serum used at the present time. The disappearance of the membrane in the throat, and the clearing up of all the toxic symptoms result in one to two days after the injection.

It is usually given in doses of 5000 to 10000 even up to 20000 units intramuscularly, and in severe cases intravenously (an antitoxic unit is the amount of antitoxin that will immunize a guinea pig weighing 250 Gms. against 100 times the fatal dose of diphtheria toxin). The injection should be repeated every 12 hours until all the symptoms disappear. It should

always be given early in the disease. In the later stages the diphtheria toxin may have already combined with the nerve cells and complications may then result, but no case is hopeless.

Diphtheria antitoxin is also given in doses of 500 to 1000 units to those who are exposed to diphtheria cases, to prevent them from contracting the disease (thus immunizing them).

Diphtheria Antitoxin (Concentrated)

Refined Diphtheria Antitoxin

(Antidiphtheritic Globulins)

These are all specially prepared antitoxins from which some of the inactive serum albumins have been removed, so that smaller quantities of serum may be used to produce the same effects.

Tetanus Antitoxin

This is the serum of a horse that has been immunized against the toxins of the Tetanus bacilli.

It is given in doses of 3000 to 20000 units every 4 to 8 hours. As an immunizing dose about 1500 units are given.

IMMUNITY TESTS

Diphtheria Immunity Test (Schick Test)

This is a test to determine the susceptibility of patients to diphtheria. Patients who are susceptible show a small area of redness when a small amount of a 1 to 1000 solution of diphtheria toxin is injected into the skin. Those who do not show such a reaction are immune to diphtheria.

Scarlet Fever Immunity Test (Dick Test)

This is a test similar to the Schick test, to determine the susceptibility of a patient to scarlet fever. The toxin is obtained by filtering a bouillon culture of strains of *Streptococcus haemolyticus* from throats of scarlet fever patients. A small amount of a 1 to 1000 solution of this toxin is injected into the skin. If the patient is susceptible, a small area of redness develops at the site of injection.

TOXIN ANTITOXIN MIXTURES

A mixture of the toxins and antitoxins of the specific bacteria are used to produce immunity to diphtheria or to scarlet fever. The mixture is more effective than either of the constituents alone. Three injections are usually given a week apart. After the injection the skin test indicating the susceptibility, becomes negative.

Diphtheria Toxin Antitoxin

This is a mixture containing the toxin of the diphtheria bacilli together with the antitoxin. It is given in three successive injections 1 c.c. each, a week apart to immunize patients who are susceptible to diphtheria.

Scarlet Fever Toxin Antitoxin

This is a mixture of the toxin and antitoxins from strains of *Streptococcus haemolyticus* obtained from the throats of scarlet fever patients. It is given in three successive injections, five days apart to immunize susceptible children and adults against scarlet fever.

Convalescent Scarlet Fever Serum

This is the serum obtained from patients convalescing from scarlet fever. It is used to immunize susceptible individuals and to treat scarlet fever.

BACTERIAL VACCINES

Bacterial vaccines are solutions of dead bacteria in normal salt solution. A 1% carbolic acid solution is usually added as a preservative.

The principle upon which the action of vaccines is based is the following: The injection of the dead bacteria into the patient causes the formation, in the serum of the blood, of a substance which excites the phagocytic action (destructive action) of the white blood corpuscles, so that they take up and destroy the bacteria of the blood more readily.

The substances formed in the serum by the dead bacteria, which increase the phagocytic action of the white blood corpuscles, are called **opsonins**.

Bacterial vaccines are used to immunize patients against infections caused by the same kind of organisms as those that are injected. There are three kinds of vaccines: Autogenous vaccines, stock vaccines, and serobacterins.

Autogenous vaccines are solutions of bacteria obtained from the patient who is being treated.

Stock vaccines are solutions of bacteria obtained from other sources.

Serobacterins are bacterial vaccines which have been sensitized by mixing them with serum of an animal that has been immunized against the same organisms. After the vaccine has been mixed, the serum is removed and the vaccine is suspended in physiological salt solution. These vaccines are said to be more effective than the ordinary vaccines.

Preparations**Staphylococcus Vaccine**

This is a solution of several strains of dead *Staphylococci* and is used in the treatment of acne, furunculosis and other *Staphylococcus* infections.

Streptococcus Vaccine

This is a solution of various strains of dead *Streptococci* in salt solution. It is used in treating *Streptococcus* infections, and for the prevention and treatment of scarlet fever.

Typhoid Vaccine

This is a solution of dead Typhoid bacilli in salt solution. It is injected into patients to prevent them from contracting typhoid fever (immunizing them against typhoid). It is given in increasing strengths in three successive injections a week apart.

Mixed Typhoid Vaccine

This is a similar vaccine containing dead Typhoid bacilli and Paratyphoid A and B bacilli.

Gonococcus Vaccine

This is a solution of dead Gonococci in normal salt solution and is used principally in the treatment of gonorrhoeal joints.

Bacillus Coli Vaccine

This is a solution of dead Colon bacilli in normal salt solution. It is used in the treatment of cystitis and kidney infections due to the colon bacillus.

Pneumococcus Vaccine

This is a solution of dead Pneumococci in normal salt solution.

There are 4 types of Pneumococci, Type 1, 2, 3, and 4. Vaccines are made from each type or from all. The latter is called Polyvalent Pneumococcus Vaccine.

Modified Pneumococcus Antigen

This is a vaccine prepared by digesting Pneumococci of Types 1, 2, 3 and 4 until they are not poisonous to guinea pigs. This vaccine is believed to be more effective than ordinary vaccines.

Pertussis Bacillus Vaccine

This is a vaccine made from the Bordet and Gengou bacillus, which is the cause of whooping cough. It is of value in preventing whooping cough.

It comes in vials of 3 different dilutions containing respectively 500, 1000 and 2000 million killed bacilli in glycerol and physiological salts solution. For treatment it comes in vials containing 1000, 2000 and 3000 million killed bacilli.

Acne Bacillus Vaccine

This is a vaccine prepared from the Acne bacillus which is the cause of some forms of acne.

Meningococcus Vaccine

This is a solution of dead Meningococci in salt solution which is used to prevent meningitis, but it is not very effective.

Cholera Vaccine

This is a solution of dead Cholera vibrios, which cause cholera. It is used to prevent attacks of Cholera.

Coley's Serum

This is a mixture of *Bacillus prodigiosus* and *Streptococci*, which is used in the treatment of sarcoma.

TUBERCULINS

Tuberculin is a liquid containing dead tubercle bacilli or their toxins in water or glycerin.

They are used as a diagnostic test for tuberculosis or for treating tuberculosis of the glands or bones. For diagnostic purposes it is injected hypodermically or applied on the skin on a scratch mark. The latter is known as the Von Pirquet test.

For treatment it is given in very minute doses gradually increased.

Old Tuberculin (Tuberculin Koch)

This is a solution obtained by filtering a bouillon culture of living tubercle bacilli through a Berkefeld filter and adding a little glycerin to it as a preservative. It contains the toxins of the tubercle bacilli. It is used to diagnose tuberculosis, by a local application to the skin on a scratch mark, or by hypodermic injection. When injected in a tuberculous patient it causes a local reaction; an area of redness; a general reaction; a rise of temperature and feeling of illness, and a focal reaction; the tuberculous process becomes slightly more active. The initial dose is 0.0002 c.c. If there is no reaction, 0.001 c.c. is injected in three days and then if there is no reaction 0.005 is injected. For treatment 0.00000001 to 0.000001 c.c. is the initial dose, which is increased every 3 days.

New Tuberculin

This is made by grinding up tubercle bacilli and mixing them with equal parts of water and glycerin. It is used principally for treatment of tuberculosis. It comes in four forms:

New Tuberculin B. E.

This is a solution of dead tubercle bacilli in a mixture of equal parts of glycerin and water. It is also ground and dried in tablet form and called,

New Tuberculin B. E. Dried

New Tuberculin T. R.

This is the ground up living tubercle bacilli preserved in glycerin. It is also dried in tablet form and called,

New Tuberculin Dried

LIVING VACCINES

The following substances contain the living organisms which cause the specific disease. They are weakened (attenuated) by drying or by other means and used to prevent the disease which they cause.

Small Pox Vaccine or Vaccine Virus

This is the pus obtained from the pustules of calves suffering with cow pox. It is obtained under sterile precautions and a little glycerin is added as a preservative. It is used for vaccination against small pox.

The principle of vaccination depends on the fact that an individual who has had an attack of cow pox, becomes immune to small pox. Vaccination produces a mild attack of cow pox at the site of the application of the virus. This develops immunity to small pox.

Antirabic Vaccine

This is an emulsion of the spinal cords of rabbits who have been inoculated with rabies (hydrophobia) poison. After the animals have been inoculated, they are killed and their spinal cords removed. The cords are dried ground and made into an emulsion in normal salt solution. This emulsion is used in the treatment and prevention of hydrophobia. The treatment is begun with the injection of a weak emulsion of a cord which has been dried for a long time, and is followed by the injection of stronger emulsions (containing cords which have been dried for a shorter time).

PREPARATIONS OF ANTIBODIES**Leucocyte Extract**

This is a fluid made by injecting a leuronat (diabetic flour) into the chest of rabbits. This forms a thick fluid (exudate) which contains a large number of white blood corpuscles. It is used in 10.0 c.c. doses in the treatment of pneumonia. It is believed to increase the number of leucocytes, which increases the resistance and help the patient to overcome the disease.

Huntoon Serum

This is a solution containing the separated antibodies produced when animals are immunized with *Pneumococcus* types 1, 2, and 3. It is used as a specific for pneumonia and the best results are obtained in pneumonia caused by *Pneumococcus*, type 1. It is given intravenously every day in 25 c.c. doses and hypodermically in 50 c.c. doses. When given intravenously it frequently causes a marked rise in temperature to 105° or 106° F.

Nuclein 0.3–0.6 Gm. grs. v–x

This is a compound of phosphorus and proteins which is said to increase the number of white blood corpuscles and thereby to destroy bacteria.

NORMAL HORSE SERUM

This is sterile serum obtained from the horse and filtered through a Berkefeld filter. It is used to help coagulate the blood in haemorrhage. Many of the serums and antitoxins contain the active ingredients in horse serum. They are therefore, apt to cause an allergic reaction (see page 460).

ALLERGIC PROTEINS

Allergens or allergic proteins are extracts of proteins which are used to prevent or relieve attacks of hay fever, asthma or urticaria, and to determine the susceptibility of the patient to proteins.

Allergy is a condition in which the patient is unusually sensitive to various proteins, such as the proteins in some foods, the pollens of some plants, the proteins of bacteria or the emanations of animal hairs or feathers.

When such patients come in contact with the proteins, pollens or animal hairs to which they are sensitive, they develop severe symptoms. If a susceptible patient happens to be in a region where certain pollens are present, or if he eats certain foods, similar symptoms develop.

The diseases which are believed to be caused by such hypersensitiveness to proteins are hay fever, asthma and urticaria or hives

In hay fever the presence in the atmosphere of the pollens of ragweed, golden rod, timothy or other plants brings on attacks of continual sneezing and secretion from the nose. The attacks occur particularly in the seasons when these pollens are most abundant.

Attacks of spasmodic bronchial asthma are frequently caused by the inhalation of emanations from animal hairs or feathers in patients who are especially susceptible. The animal hairs which principally cause these attacks are horsehair, rabbits' hair and goose or chicken feathers. Urticaria or hives may also be produced in some people when they eat certain kinds of foods, for example, strawberries.

Any of these conditions may also occur from infections with certain bacteria.

ACTION

Protein Skin Tests

When a patient is susceptible to certain proteins, the application of the dried protein on a scratch mark, or the injection of a dilute solution of it, produces a wheal, which is a large elevated red spot similar to the spots which occur in hives. The degree of susceptibility is sometimes determined by repeating the test with a number of weaker solutions, each succeeding injection being weaker than the preceding one.

In patients suffering from hay fever, the application of extracts of the pollens of ragweed, timothy, golden rod and other plants produces such a reaction.

In some cases of asthma, the application on the skin, of dried protein extracts of animal hairs, such as horsehair, rabbits' hair, or feathers, produces a wheal. Occasionally extracts of various foods or bacteria, also produce such a reaction.

In some cases of urticaria or hives the application of protein extracts of strawberries, eggs or other foods produces a similar reaction

Prevention and Treatment of Allergy

In cases of asthma or urticaria, the attacks may frequently be prevented by eliminating the causative protein from the food or from the environment. Thus, if the hives is due to strawberries or eggs, the attacks are often prevented when these foods are eliminated from the diet. Attacks of asthma which are due to horse hair are often prevented when the hair mattresses are re-

moved from the bed or when the patient is removed from a locality where there are many horses. If the attacks are due to feathers, they may be prevented by avoiding the use of feather pillows.

In hay fever, the change of environment alone is usually not sufficient to relieve the attacks. The patient also has to be immunized against the specific pollens which cause the attacks. Since this treatment lessens the susceptibility to attacks, it is called **desensitization**.

This preventive treatment usually consists of 15 consecutive injections of dilute solutions of the specific pollens in increasing strengths, and is given about 6 weeks before the expected onset of the disease, which is usually in June or August. The treatment is also given during the attacks to lessen their severity. The immunity only lasts for about a year.

Patients suffering with urticaria or asthma are also sometimes desensitized to the specific protein which causes the attack. In cases of asthma due to animal hairs, extremely dilute solutions must be used for desensitization, as poisonous symptoms (allergic reaction) occur very readily from such solutions.

Poisonous Effects

Anaphalaxis, Serum Sickness, or Allergic Reaction

The injection of large doses of allergens, or of a serum, in susceptible patients, causes some or all of the following symptoms:

1. Fever.
2. Headache.
3. Urticaria (hives).
4. Oedema of various parts of the body.
5. Attacks of asthma.
6. Collapse.

The symptoms may be avoided by giving small doses of very dilute solutions of allergens. When a serum is used, it should be determined whether the patient has been subject to attacks of asthma or hives, or whether previous injections of a serum have caused these symptoms. The injection of epinephrine or adrenalin, or atropine, usually relieves the symptoms.

Preparations

Pollen Extracts

Pollen Allergens

Pollen Antigens

These come in two forms, either as a powder or liquid for testing, or in ampoules for desensitizing the patient. The most common pollen allergens are various types of ragweed and timothy, golden rod and various grasses.

Food Allergens**Food Protein Extracts**

These are extracts of various foods prepared in powder form, in pastes and in ampoules for testing and for treatment. The most common food allergens are eggs, milk, meat, fish, fruit, vegetables, cereals and berries.

Animal Hair Allergens**Animal Hair Protein Extracts**

These occur in powders or in extremely dilute solutions, both for testing and for immunizing. The most commonly used preparations are extracts of goose feathers, chicken feathers, horsehair, rabbits' hair and various furs.

Bacterial Allergens**Bacterial Protein Extracts**

These are extracts of dried bacteria, such as Staphylococci, Streptococci and other bacteria.

Group Allergens**Group Protein Extracts**

This consists of equal parts of two or more protein extracts or allergens. It comes in powder form or in vials for testing. If a positive test is obtained, the patient is tested with the single proteins of the group.

Dunbar's Serum (Pollantin)

This is the serum of horses that have been immunized against the pollens of ragweed or timothy. It is used in the treatment of hay fever applied locally or given hypodermically.

PROTEIN SHOCK TREATMENT

The injection of various proteins into the veins or when given intramuscularly, produces a very severe reaction, consisting of a severe chill with a rise in temperature to 105° or 106° F., perspiration and general weakness. It has been found that when injections of proteins produce such a reaction, the pains and stiffness in the joints of chronic rheumatism are greatly relieved. The substances used for this purpose are either a mixed typhoid vaccine given in doses of 25 to 100 million at a time, sterilized milk, or preparations made from milk.

Preparations

Mixed Typhoid Vaccine

This is a vaccine containing 50 million Typhoid bacilli and 25 million each of Paratyphoid bacillus A & B in each c.c. ampoule. It is given intravenously for protein shock treatment in chronic rheumatism.

Sterilized Milk

About 5 to 6 c.c. of boiled milk are given intravenously, or intramuscularly.

Aolan

This is a derivative of milk which is free from bacteria and poisonous substances. It is given in doses of 0.2 to 0.3 c.c. intramuscularly and subcutaneously in chronic rheumatism and chronic infections of the joints, skin, etc.

APPENDIX

THE HARRISON LAW

The Harrison Law went into effect March 1, 1915. It was passed to regulate the sale and use of habit-forming drugs such as opium, cocaine or their derivatives so as to prevent the occurrence of the habit. The following are the essential features of the law:

1. Every wholesale and retail druggist who sells opium, cocaine, or their derivatives must be registered annually with the Department of Internal Revenue and pay an annual tax of one dollar. They are permitted to sell any of the substances listed under the law only upon the written order of a physician, pharmacist or dentist who is also registered with the Department of Internal Revenue. They must keep a record of each sale and give the purchaser a duplicate. All records must be kept for a period of two years and are subject to inspection by officials of the Department of Internal Revenue at any time.

2. Every physician and dentist must be registered with the Department of Internal Revenue and pay an annual tax of one dollar. They must keep a record of the quantities, and drugs obtained, and of their disposal. These records are subject to inspection at any time. Prescriptions calling for any substance listed under the Harrison law must bear the physician's name, address and registry number. They must also contain the patient's name, age and address, and must be dated on the day they are written and signed by the physician ordering them.

3. Any unauthorized person who has any of the substances listed under the law in his possession is subject to a fine of \$2,000 or five years imprisonment or both.

List of Drugs under the Harrison Law

Opium	Coca
Opium Powder	Fluidextract of Coca
Opium tablets (all strengths)	Cocaine
Extract of Opium	Cocaine Hydrochloride
Dover's Powder	Cocaine tablets (all strengths and combinations)
Tincture of Dover's powder	Codrenin
Tinctura Opii Simplex	Eucaïne
Tincture of Deodorized Opium	Holocaine
Morphine Sulphate (all strengths and all tablets)	Novocaine or Procaine
Magendie's Solution	Tropacocaine
Codeine and its salts	Anaesthesia
Codeine tablets (all strengths)	Orthoform
Dionine (all strengths)	
Codeonal	
Heroin (all tablets and all strengths)	
Papaverine	

Pantopon

Apomorphine Hydrochloride

Stypticin

Styptol

In addition, all mixtures or prescriptions containing opium, coca, or their derivatives except the following:

1. Preparations that contain less than grs. ii of opium in every ounce.
2. Preparations that contain less than gr. $\frac{1}{4}$ of morphine, gr. i of codeine or gr. $\frac{1}{8}$ of heroin, in every ounce.
3. Liniments or ointments which are used externally, except those containing cocaine or eucaine (alpha or beta), or any of their salts or synthetic substances.

Application of the Harrison Law in Hospitals

Every hospital must be registered with the Department of Internal Revenue and receives a registry number and is subject to the same regulations as physicians.

By the following method a record may be kept of the quantities used of the drugs listed under the Harrison law.

1. Substances listed under the Harrison law must be ordered for ward use on special blanks upon which appears the hospital registry number. All drugs listed in the Harrison law must be ordered on one of these blanks and be signed by a physician.

2. Every order calling for opium, coca, or any of their derivatives must be signed by the physician who orders it, both in the order book and on the chart.

3. A special book should be kept in every ward, in which the nurse enters the name, date, journal number, the dose and the drug given. In this book the nurse is therefore able to account for the quantities of Harrison law drugs obtained from the pharmacist. If a bottle containing any drug listed under the Harrison law is broken, a record of it should also be made.

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